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Issued July, 1945

Soil Survey

Princess Anne County Virginia

By
C. S. SIMMONS
United States Department of Agriculture, in Charge
and
EDWARD SHULKCUM
Virginia Agricultural Experiment Station

UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Research Administration
Bureau of Plant Industry, Soils, and
Agricultural Engineering
In cooperation with the
Virginia Agricultural Experiment Station

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HOW TO USE THE SOIL SURVEY REPORT

SOIL SURVEYS PROVIDE a foundation for all land use programs. This report and the accompanying map present information both general and specific about the soils, the crops, and the agriculture of the area surveyed. The individual reader may be interested in the whole report or only in some particular part. Ordinarily he will be able to obtain the information he needs without reading the whole. Prepared for both general and detailed use, the report is designed to meet the needs of a wide variety of readers of three general groups: (1) Those interested in the area as a whole; (2) those interested in specific parts of it; and (3) students and teachers of soil science and related agricultural subjects. Attempt has been made to meet the needs of all three groups by making the report comprehensive for purposes of reference.

Readers interested in the area as a whole include those concerned with general land use planning—the placement and development of highways, power lines, docks, urban sites, industries, community cooperatives, resettlement projects, and areas for forest and wildlife management and recreation. The following sections are intended for such users: (1) General Nature of the Area, in which location and extent; physiography, relief, and drainage; climate; vegetation; organization and population; and industries, transportation, and markets are discussed; (2) Agriculture, in which a brief history and the present status of the agriculture are described; (3) Land Use and Soil Management, in which the present uses of the soils are described, their management requirements discussed, and suggestions made for improvement.

Readers interested chiefly in specific areas—such as some particular locality, farm, or field—include farmers, agricultural technicians interested in planning operations in communities or on individual farms, and real estate agents, land appraisers, prospective purchasers and tenants, and farm loan agencies. These readers should (1) locate on the map the tract with which concerned; (2) identify the soils on the tract by locating in the legend on the margin of the map the symbols and colors that represent them; and (3) locate in the table of contents in the section on Soils the page where each type is described in detail and information given as to its suitability for use and its relations to crops and agriculture. They will also find useful specific information relating to the soils in the sections on Land Use and Soil Management and Estimated Yields.

Students and teachers of soil science and allied subjects—including crop production, forestry, animal husbandry, economics, rural sociology, geography, and geology—will find their special interest in the section on Morphology and Genesis of Soils. They will also find useful information in the section on Soils, in which are presented the general scheme of classification of the soils of the area and a detailed discussion of each type. For those not already familiar with the classification and mapping of soils, these subjects are discussed under Soil Survey Methods and Definitions. Teachers of other subjects will find the sections on General Nature of the Area, Agriculture, Land Use and Soil Management, and the first part of the section on Soils of particular value in determining the relations between their special subjects and the soils in the area.

This publication on the soil survey of Princess Anne County, Va., is a cooperative contribution from the—

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Series 1939, No. 3 Issued July, 1945

SOIL SURVEY OF PRINCESS ANNE COUNTY, VIRGINIA

By C. S. SIMMONS, Division of Soil Survey, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, United States Department of Agriculture, in Charge, and EDWARD SHULKCUM, Virginia Agricultural Experiment Station

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United States Department of Agriculture in cooperation with the Virginia Agricultural Experiment Station

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SUMMARY

Princess Anne County, occupying the eastern part of the mainland of Virginia, lies between Norfolk and the Atlantic Ocean and includes the well-known Virginia Beach resort. Except for some hilly areas of dune sand near Cape Henry, which reach an elevation of almost 100 feet, the surface relief of its 270 square miles ranges from nearly level to very gently undulating. Only about 20 percent of the soil is naturally well drained. Considerable areas of the flat almost level soils have been artificially drained by canals, supplemented by small open lateral ditches.

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The climate is mild and rainfall is abundant and well distributed throughout the year. Summer heat is tempered by breezes from the ocean. The frost-free season is long, and many hardy truck crops can be grown in winter.

Explorers who established the first permanent English settlement at Jamestown landed first at Cape Henry in April 1607 to reconnoiter and obtain water. The first settlement in the county, near the mouth of Lynnhaven Bay, was not made until 1621. About 30 percent of the land area is cultivated, principally for a variety of truck crops, potatoes, sweetpotatoes, strawberries, corn, and soybeans. Dairying is practiced to some extent, and the products are sold on the Norfolk market.

The soils are mapped as 24 types and phases in 4 groups, according to drainage conditions, and 10 separations classed as miscellaneous land types.

The well-drained soils include the Sassafras, Woodstown, Norfolk, and Craven series. The first two of these soils are similar in characteristics to some of those on the eastern shore of Virginia and Maryland, whereas the last two are representative of the seaward part of North Carolina. Most of the truck crops, vegetables, and strawberries are grown on these soils, which have a wide crop adaptation and when properly fertilized and managed produce good yields.

The soils of the Lenoir, Moyock, and Dragston series comprise the imperfectly drained group. Though not so well drained as those of the first group, in many places they occur in close association with them. Some vegetables and truck crops, especially potatoes, are produced, but these soils are better adapted to growing corn, soybeans, and other staple crops. Artificial drainage is required to obtain the best yields and to render these soils suitable for growing a wide variety of crops.

The light-colored poorly drained soils include the Bladen, Elkton, and Fallsington series. Bladen silt loam occurs in large continuous areas and has a flat almost level surface. As these soils are poorly drained, all require artificial drainage for agricultural purposes. The principal crops are corn and soybeans, but some potatoes and strawberries are produced.

The dark-colored poorly drained soils, of the Bayboro, Portsmouth, and Hyde series, have a high content of well-decomposed and disseminated organic matter. All are very poorly drained, but when artificially drained and limed they produce large yields of corn and soybeans and in some places good yields of potatoes. Inherently they are good strong soils.

The miscellaneous land types—coastal beach, dune sand and its stabilized phase, tidal marsh, marsh, swamp, swamp-dune sand complex, Arzell sand, pits, and made land—are mainly classification of material and not definite soil types. At present they are practically nonagricultural except for furnishing scant grazing to cattle and for small quantities of firewood. The sands are used largely for home sites, whereas the marshes and swamps are used to some extent as wildlife refuges.

Large areas of potentially fertile soil could be reclaimed for agricultural purposes by artificial drainage and made to produce good yields of corn, soybeans, potatoes, truck crops, and pasture grasses.

The soils are acid to extremely acid and are benefited by the application of lime. Soils that are particularly well drained and the lighter textured ones that have good physical qualities respond readily to commercial fertilizer. By reason of its soils, favorable climate, and good location with respect to transportation to northern markets, the county offers possibilities for future agricultural development.

GENERAL NATURE OF THE AREA

LOCATION AND EXTENT

Princess Anne County is a roughly rectangular area in the extreme southeastern part of Virginia (fig. 1). The northern edge extends

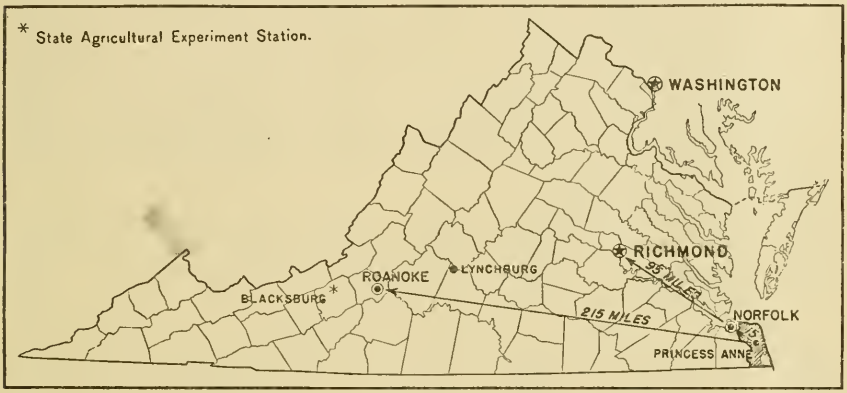

FIGURE 1.—Location of Princess Anne County in Virginia.

along Chesapeake Bay about 14 miles, and the eastern edge along the Atlantic Ocean from Cape Henry to the Virginia-North Carolina State line, about 25 miles. The total area is 270 square miles, or 172,800 acres. Virginia Beach, a well-known ocean resort and the largest town, is 18 miles southeast of Norfolk.

PHYSIOGRAPHY, RELIEF, AND DRAINAGE

Princess Anne County lies in the Coastal Plain physiographic division of the United States and in the Tidewater section of Virginia. It occupies a nearly level plain that in Virginia is divided into the Princess Anne and the Dismal Swamp terraces, both of which are of marine origin and of gently undulating to level relief. No fluvial deposits have been recognized within the county.[1] The Princess Anne terrace, ranging in elevation from sea level to about 15 feet, borders the ocean and Chesapeake Bay; and the Dismal Swamp terrace, with a maximum elevation of about 25 feet, covers the central and western parts of the county. These terraces are separated by a low escarpment that is almost imperceptible in most places but can be seen clearly just north of Beech Grove, where there is a distinct rise of about 5 feet.

[1] WENTWORTH, C. K. SAND AND GRAVEL RESOURCES OF THE COASTAL PLAIN OF VIRGINIA. Va. Geol. Survey Bul. 32, 147 pp., illus. 1930.

Dissection is neither complete nor thorough, and many large areas have no natural surface drainage. Most of the natural drainageways reach sea level within a few miles of their source, and no part of the county is more than 8 miles from a point that lies at sea level. Apparently the land is sinking slowly. Drainage in the northern part is effected through Lynnhaven Bay, the Eastern Branch Elizabeth River, and Little Creek, which flow into Chesapeake Bay; and in the southern part through North Landing River and Back Bay, which are tributary to Currituck Sound. A few square miles in the extreme southwestern part drain through the Northwest River, also tributary to Currituck Sound, and a small area in the vicinity of Virginia Beach drains directly into the Atlantic Ocean through Rudy Inlet. This is the only break in the coast line between the mouth of Lynnhaven Bay (Lynnhaven Inlet) on Chesapeake Bay and Oregon Inlet in North Carolina, a distance of about 100 miles. Back Bay, famous for waterfowl hunting, is a shallow fresh-water or very slightly brackish lake with marshy borders, comprising about 50 square miles in the southeastern part of the county. It is separated from the ocean by a narrow ridge of beach and dune sand and receives salt water during very severe storms. This is the site of the Federal Back Bay Migratory Bird Refuge.

Although the average elevation is about 20 feet, some of the sand dunes in the vicinity of Cape Henry reach a height of almost 100 feet. Local variations in elevation are slight, and there are nearly level areas, broken only by slight depressions, hummocks, and ridges, where the variation is less than 5 feet over a stretch of several square miles. The greatest local variations, other than the sand dunes, which are characterized by hilly relief, occur along Lynnhaven Bay, where many of the precipitous or overhanging banks are 20 to 25 feet high.

CLIMATE

The climate of Princess Anne County is oceanic; that is, it is moderated by the proximity of the Atlantic Ocean and Chesapeake Bay. The summers are long and temperate, but there are a few very hot days; the winters are mild, with very few days below freezing. Hardy crops, as spinach, kale, collards, turnips, turnip greens, and cabbage, are grown throughout the winter, and tender crops can be safely planted the first of April. The average frost-free season is 225 days (April 1 to November 11) at Diamond Springs, and 245 days (March 20 to November 20) at Cape Henry. Rainfall is adequate and well distributed throughout the year, and long periods of drought seldom occur. Wind velocities of 30 miles an hour are not uncommon, but these do little or no damage. Small areas along the coast are inundated with salt water during the infrequent but very severe northeast storms. Destructive wind, hail, or ice storms are almost unknown, as this section lies far enough south to escape the severe winters of northern United States and far enough north to escape the tropical storms of the Gulf States.

The normal monthly, seasonal, and annual temperature and precipitation at Diamond Springs and Cape Henry are given in table 1. These data are representative of the county as a whole.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at two stations in Princess Anne County, Va.*[1]

DIAMOND SPRINGS, ELEVATION, 25 FEET

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total for the driest year	Total for the wettest year	Average snowfall
	°F.	°F.	°F.	Inches	Inches	Inches	Inches
December	44.3	80	9	4.15	4.54	5.23	1.2
January	43.3	79	2	3.54	4.15	2.22	2.5
February	43.7	90	5	3.34	2.30	3.93	1.2
Winter	43.8	90	2	11.03	10.99	11.38	4.9
March	49.8	91	14	3.62	2.60	3.22	2.2
April	57.8	96	23	3.27	2.98	4.35	(2)
May	65.8	96	35	4.15	2.13	10.35	0
Spring	57.8	96	14	11.04	7.71	17.92	2.2
June	73.7	99	44	5.11	4.82	8.35	0
July	77.6	102	51	5.54	2.70	6.25	0
August	76.6	103	51	4.28	1.69	7.25	0
Summer	76.0	103	44	14.93	9.21	21.85	0
September	72.4	97	42	3.71	2.30	9.71	0
October	62.7	94	28	2.94	2.40	.35	0
November	52.2	85	15	2.36	1.05	2.70	(2)
Fall	62.4	97	15	9.01	5.75	12.76	(2)
Year	60.0	[3] 103	[4] 2	46.01	[5] 33.66	[6] 63.91	7.1

CAPE HENRY, ELEVATION, 16 FEET

December	43.7	78	7	3.44	1.35	5.28	1.5
January	40.2	79	6	3.15	4.39	5.59	2.0
February	41.2	84	5	3.31	1.29	1.06	2.3
Winter	41.7	84	5	9.90	7.03	11.93	5.8
March	46.6	90	12	3.87	1.02	6.29	1.3
April	54.6	97	26	3.30	.93	6.89	(2)
May	64.2	98	41	3.57	3.30	2.88	0
Spring	55.1	98	12	10.74	5.25	16.06	1.3
June	72.9	102	48	3.96	3.14	4.61	0
July	77.5	102	55	5.37	2.57	6.48	0
August	76.9	103	57	4.86	1.21	3.32	0
Summer	75.8	103	48	14.19	6.92	14.41	0
September	71.8	99	47	2.86	.46	10.04	0
October	62.1	92	35	3.01	2.73	6.79	0
November	52.1	86	19	2.36	.83	5.44	(2)
Fall	62.0	99	19	8.23	4.02	22.27	(2)
Year	58.7	[7] 103	[8] 5	43.06	[9] 23.22	[10] 64.67	7.1

[1] Records from U. S. Weather Bureau.
[2] Trace.
[3] August 1917.
[4] January 1918.
[5] In 1930.
[6] In 1924.
[7] August 1881.
[8] February 1889.
[9] In 1915.
[10] In 1877.

VEGETATION

Originally this area was densely wooded, probably with the same species of trees as are growing today. The forests have been largely cut over one or more times, but about 94,000 acres, a little more than half the total area of the county, are still in forest. Loblolly pine

is the most common tree, and in many places an even-aged pure stand develops in abandoned fields on both well-drained and imperfectly drained situations. Red oak, white oak, hickory, and holly are found in old forests on well-drained areas; beech, sycamore, sweetgum, black tupelo, yellow poplar, and red maple are common on the wetter areas; and cypress is in swamps. Most areas have a thick undergrowth of gallberry, waxmyrtle, greenbrier, blackberry, wild grape, and, in poorly drained places, cane or reeds. The tidal and fresh-water marshes support a dense growth of coarse reedy grasses, the species differing in the two types. Cattails are common in the latter.

Following is a list of the more important trees and plants of the county:

Acer rubrum L.	Red maple.
Arundinaria tecta (Walt.) Muhl.	Cane.
Carya glabra (Mill.) Sweet (*Hicoria glabra*)	Pignut hickory.
Cornus florida L.	Dogwood.
Fagus grandifolia Ehrh.	Beech.
Ilex glabra (L.) A. Gray	Gallberry.
I. opaca Ait.	Holly.
Liquidambar styraciflua L.	Sweetgum.
Liriodendron tulipifera L.	Yellow poplar.
Myrica cerifera L. (*M. caroliniensis*)	Waxmyrtle.
Nyssa sylvatica Marsh.	Black tupelo; sour gum.
Platanus occidentalis L.	Sycamore.
Pinus taeda L.	Loblolly pine.
Quercus alba L.	White oak.
Q. falcata Michx. (*Q. rubra*)	Red oak.
Rubus allegheniensis Porter (*R. nigrobaccus*)	Blackberry.
Smilax sp.	Greenbrier.
Taxodium distichum (L.) Rich.	Cypress.
Typha latifolia L.	Cattail.
Vitis riparia Michx.	Wild grape.
Zanthoxylum americanum Mill.	Prickly-ash.

ORGANIZATION AND POPULATION

It was at Cape Henry, on April 26, 1607, that the settlers who later established the first permanent English settlement at Jamestown first set foot on American soil, to reconnoiter and obtain water. The first settlement in what is now Princess Anne County was made in 1621, when Adam Thoroughgood established a home near the mouth of Lynnhaven Bay. Later, about 1640, he built a brick house, which is still standing and is said to be the oldest residence in Virginia.

Princess Anne County was formed from lower Norfolk County in 1691 and the present boundary was established in 1921. Prior to the Revolutionary War, both Lynnhaven (a town near the mouth of Lynnhaven Bay, not the site of the present village of that name) and Kempsville were important ports of entry. The first agricultural fair in Virginia is said to have been held at Kempsville in 1852. The first court was held at Lynnhaven in 1637. The county seat was later (1692) moved to the vicinity of Old Donation Church, then (1751) to Newtown on the Eastern Branch Elizabeth River (about 2 miles west of the present town of Kempsville), then (1778) to Kemps Landing (now Kempsville), and finally (in 1824) to Princess Anne. the present site in the center of the county.[2]

[2] WHITE, B. D. GLEANINGS IN THE HISTORY OF PRINCESS ANNE COUNTY. 19 pp. 1924. Norfolk, Va.

The early settlers came from England, and there was some influx from North Carolina and other parts of Virginia. Recently several Mennonite families from Pennsylvania and Ohio have settled in the vicinity of Kempsville.

According to the 1940 census, native-born whites constitute 60.1 percent of the population and Negroes (native-born descendants of former slaves) 38.8 percent. The total population, all classed as rural, is 19,984. Virginia Beach (population 2,600) is the largest town, and other villages, all of which have less than 1,000 inhabitants, are Oceana, Londonbridge, Lynnhaven, East Ocean View, Princess Anne, Kempsville, Pungo, and Creeds. All except East Ocean View are important locally as trading centers and concentration points for farm produce.

Elementary schools are centrally located, and transportation is furnished all pupils who live some distance from them. High schools are maintained at Creeds, Oceana, Kempsville, and Euclid. Many rural churches have been abandoned and many farmers must travel to Norfolk or Virginia Beach to attend services.

The Virginia Truck Experiment Station is located at Diamond Springs (pl. 1), but its post-office address is Norfolk, Va. The Farm Bureau has recently been organized to promote the social and economic welfare of rural residents. Telephones and electricity for lighting and power are available to most farms.

INDUSTRIES

There are no large industries within the county, but many men find part- or full-time employment in fishing, oystering, and crabbing. The oysters from Lynnhaven Bay are famous for size and quality. Lumbering furnishes full-time employment to many loggers and part-time employment to many farmers. As most of the timber is sawed in portable mills, there are no large sawmills. Brickyards are at Oceana and Lynnhaven.

TRANSPORTATION AND MARKETS

Hard-surfaced roads reach all parts of the county, and earth roads are well maintained. Norfolk, important for its seaport and railhead, is easily accessible by car or truck from all parts during all seasons. A passenger and vehicle ferry, capable of carrying the largest trucks, operates between Little Creek and Cape Charles on the Eastern Shore and materially shortens the time required to reach markets in Philadelphia and New York. The Norfolk Southern Railroad reaches all towns in the county, and the Pennsylvania Railroad crosses the northwestern part to its ferry dock at Little Creek, where cars are ferried to Cape Charles. In addition to that shipped by rail, much produce is shipped by truck to Washington, Baltimore, Philadelphia, New York, and other northern markets, most of which can be reached by truck in less than 14 hours. The Chesapeake and Albemarle Canal, part of the Intracoastal Waterway, passes through this county.

Most of the milk produced in the county is sold in bottles in Norfolk. Many of the swine raised are sold in Richmond or Baltimore, but some farmers keep only breeding stock, and ship young pigs to other parts of Virginia.

AGRICULTURE

Agriculture in Princess Anne County began at a very early date, as the Indians were growing corn when white men arrived early in the seventeenth century. From the standpoint of acreage, corn has continued to be the most important crop for more than 300 years. The early settlers occupied the well-drained sandy land bordering Lynnhaven Bay, the Eastern Branch Elizabeth River, Back Bay, and the ridge, now known as Pungo Ridge, which traverses the central part of the county. Many houses are standing today that were built before the Revolutionary War.[3] Settlement continued into the less well-drained parts of the county as open drainage ditches were dug.

Early agriculture consisted of raising corn, wheat, and livestock for subsistence and tobacco as a cash crop. In recent years the growing of vegetables (potatoes, sweetpotatoes, and green vegetables) and strawberries and dairying have received special emphasis. The acreage in potatoes increased from 3,643 to 4,040 between 1929 and 1939 and they became the most important cash crop. Rapid transportation, which allows succulent vegetables to be shipped to distant markets, was responsible for the increase of vegetable production, and the growth of the city of Norfolk was responsible for the increase in dairying. Dairying is also receiving increasing emphasis, as the number of cows 2 years old and older increased from 2,042 to 2,439 during the same period. The most popular breeds of dairy cattle are Guernsey and Holstein-Friesian.

The important trends in recent agriculture are shown in tables 2 and 3.

TABLE 2.—*Number and value of farms, and area and improved land in farms in Princess Anne County, Va., in stated years*

Year	Farms	Average size of farms	Land in farms		Improved land			Value of land and buildings	
					Total	Per farm		Per farm	Per acre
	Number	*Acres*	*Acres*	*Percent*	*Acres*	*Acres*	*Percent*	*Dollars*	*Dollars*
1880	917	123.0	112,493	63.0	50,648	55.2	45.0	1,506	12.28
1890	900	129.0	115,661	64.8	62,231	69.1	53.8	2,197	17.10
1900	1,432	82.8	118,529	66.4	71,029	49.6	59.9	1,672	20.20
1910	1,423	71.8	102,120	57.2	63,232	44.4	61.9	2,919	40.68
1920	1,317	71.8	94,544	52.9	60,325	45.8	63.8	6,008	83.69
1930	1,180	76.3	90,050	49.4	55,718	47.2	60.1	7,736	101.37
1940	939	93.3	87,597	51.3	53,312	56.8	60.2	6,220	66.68

TABLE 3.—*Acreage of principal crops in Princess Anne County, Va., in stated years*

Crop	1879	1889	1899	1909	1919	1929	1939
Corn:	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*
Harvested for grain	28,573	25,647	32,718	34,192	31,714	20,283	15,506
For other purposes					1,380	1,002	1,227
Wheat	109	3		30	497	181	413
Barley		2				23	305
Rye	15	94	12	10		35	415
Oats:							
Threshed	1,138	876	816	32	297	232	634
Cut and fed unthreshed						248	142

[3] KELLAM, S. S., and KELLAM, V. H. OLD HOUSES IN PRINCESS ANNE, VIRGINIA. 235 pp., illus. 1931. Portsmouth, Va.

The mechanical analysis of a sample of Sassafras fine sandy loam [9] from Accomac County, Va., is given in table 9.

TABLE 9.—*Mechanical analysis of a sample of Sassafras fine sandy loam from Atlantic, Accomac County, Va.*[1]

Sample No.	Horizon	Depth	Material and diameter of particles (in millimeters)						
			Fine gravel (2.0–1.0)	Coarse sand (1.0–0.5)	Medium sand (0.50–0.25)	Fine sand (0.25–0.10)	Very fine sand (0.10–0.05)	Silt (0.050–0.005)	Clay (0.005–0)
		Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
29419	A	1½–10	0.4	2.2	3.7	49.4	6.0	31.4	6.8
29420	B	13–34	0	1.2	2.4	48.0	4.9	13.5	29.8
29421	C	34–53	0	1.3	2.9	75.2	7.4	6.7	6.6

[1] MARBUT, C. F. SOILS OF THE UNITED STATES. U. S. Dept. Agr. Atlas Amer. Agr., pt. 3, Adv. Sheets No. 8, p. 31. 1935.

The sample from Atlantic, Va., has a well-defined color and texture profile. The mechanical analysis shows the percentage of clay in the A, B, and C horizons to be 6.8, 29.8, and 6.6 percent, respectively. The chemical analysis (table 10) shows an apparent accumulation of aluminum in the B horizon and of silica in the A horizon.

The chemical analysis of Sassafras fine sandy loam,[10] table 10, compared with Norfolk fine sandy loam in table 12 shows a much higher percentage of Fe_2O_3, CaO, MgO, K_2O, Na_2O, and P_2O_5 in the former. This clearly indicates that the fine sandy loam in the Sassafras series is inherently a stronger and richer soil than that in the Norfolk.

TABLE 10.—*Chemical analysis of Sassafras fine sandy loam from Atlantic, Accomac County, Va.*[1]

Sample No.	Horizon	Depth	SiO_2	TiO_2	Fe_2O_3	Al_2O_3	MnO	CaO	
		Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	
29419	A	1½–10	*a*85.96	0.59	1.74	6.26	0.04	0.40	
			*b*87.61	.60	1.77	6.38	.04	.41	
29420	B	13–34	*a*81.05	.59	3.21	9.13	.03	.20	
			*b*83.38	.61	3.30	9.39	.03	.21	
29421	C	34–53	*a*87.38	.41	1.26	6.32	.01	.46	
			*b*88.39	.41	1.27	6.39	.01	.46	

Sample No.	Horizon	Depth	MgO	K_2O	Na_2O	P_2O_5	SO_3	Ignition loss	N
		Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
29419	A	1½–10	*a*0.36	1.54	0.58	0.02	0.07	1.91	0.02
			b.37	1.57	.59	.02	.07		
29420	B	13–34	*a*.40	1.65	.49	.02	.05	2.80	.02
			b.41	1.70	.50	.02	.05		
29421	C	34–53	*a*.18	1.75	.76	.01	.05	1.15	.01
			b.18	1.76	.77	.01	.05		

[1] MARBUT, C. F. SOILS OF THE UNITED STATES. U. S. Dept. Agr. Atlas Amer. Agr., pt. 3, Adv. Sheets No. 8, p. 31. 1935.

[9] Although the soil is classed as Sassafras sandy loam in the Atlas of American Agriculture, the mechanical analysis reveals it to be definitely a fine sandy loam, and in comparing the data with those of Norfolk fine sandy loam this soil should be considered as a fine sandy loam.

[10] See footnote 7, p. 51.

The mechanical analysis [11] of Norfolk fine sandy loam 3 miles north of Bests, Wayne County, N. C., is given in table 11. Two outstanding features are shown by these data: (1) The extent to which the clay has been transferred from the A horizon to both the lower horizons and (2) the uniform content of silts and sands in the three horizons. This latter fact becomes obvious when the percentages of the silts and sands are figured on a clay-free basis. The large quantity of this coarser material and its uniform distribution throughout the profile, together with the low water table, no doubt have contributed to the transfer of the clay from the upper part of this soil.

TABLE 11.—*Mechanical analysis of Norfolk fine sandy loam* [1]

Sample No.	Horizon	Depth	Material and diameter of particles (in millimeters)				
			Fine gravel (2.0–1.0)	Coarse sand (1.0–0.5)	Medium sand (0.50–0.25)	Fine sand (0.25–0.10)	
		Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
C294	A	0–12	1.7	6.6	9.9	25.9	
C295	B	12–34	1.0	5.1	7.7	20.4	
C296	C	36–80	1.2	4.8	7.9	19.7	

Sample No.	Horizon	Depth	Material and diameter of particles (in millimeters)				Organic matter by H_2O_2
			Very fine sand (0.10–0.05)	Silt (0.050–0.005)	Clay (0.005–0.002)	Colloid (0.002–0)	
		Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
C294	A	0–12	17.8	28.4	8.9	4.9	0.07
C295	B	12–34	14.0	22.7	28.8	23.5	.02
C296	C	36–80	13.7	21.3	31.3	30.1	0

[1] Determinations by laboratories of Bureau of Plant Industry, Soils, and Agricultural Engineering.

The chemical analyses of the three horizons of Norfolk fine sandy loam are given in table 12. The variations in this soil profile are characteristic of a mature profile developed under good drainage and oxidation. This is evidenced by the structure, color, and location of the clay, as pointed out in the description of the soil and by its mechanical analysis. The chemical data given in the table show a pronounced transfer of the major constituents from the A horizon to the lower horizon, as indicated by decrease of silica and increase of sesquioxides. The nature of this transfer is better interpreted from the subsequent data on the colloidal fraction of this soil (table 13). The whole soil has a very low yet uniform content of the minor constituents.

[11] HOLMES, R. S., HEARN, W. E., and BYERS, H. G. THE CHEMICAL COMPOSITION OF SOILS AND COLLOIDS OF THE NORFOLK AND RELATED SOIL SERIES. U. S. Dept. Agr. Tech. Bul. 594, 33 pp., illus. 1938.

TABLE 12.—*Chemical analysis of Norfolk fine sandy loam*[1]

Sample No.	Horizon	Depth	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	MnO	CaO	MgO	
		Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	
C294	A	0–12	94.26	1.01	2.08	0.69	0.01	0.07	0.03	
C295	B	12–34	82.67	1.14	8.87	3.18	.01	.08	.02	
C296	C	36–80	78.99	1.05	11.03	4.45	.02	.01	.05	

Sample No.	Horizon	Depth	K_2O	Na_2O	P_2O_5	SO_3	Ignition loss	pH	N	Organic matter
		Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*		*Percent*	*Percent*
C294	A	0–12	0.03	0.01	0.01	0.01	1.67	5.1	0.02	0.89
C295	B	12–34	.07	.01	.02	.02	3.64	4.6	.03	.40
C296	C	36–80	.02	.03	.01	.03	4.18	4.6	.02	.24

[1] Determinations by laboratories of Bureau of Plant Industry, Soils, and Agricultural Engineering.

TABLE 13.—*Chemical analysis of the colloid of Norfolk fine sandy loam*[1]

Sample No.	Horizon	Depth	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	MnO	CaO	
		Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	
C294	A	0–12	35.97	1.23	32.14	10.70	0.01	0.35	
C295	B	12–34	37.54	1.10	34.41	12.41	.01	.50	
C296	C	36–80	38.73	.90	34.10	11.97	.01	.28	

Sample No.	Horizon	Depth	MgO	K_2O	Na_2O	P_2O_5	SO_3	Ignition loss	Organic matter
		Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
C294	A	0–12	0.58	0.52	0.18	0.10	0.12	17.83	4.65
C295	B	12–34	.52	.53	.27	.10	.11	14.03	1.06
C296	C	36–80	.42	.30	.20	.07	.09	14.29	.77

[1] Determinations by laboratories of Bureau of Plant Industry, Soils, and Agricultural Engineering.

The soils developed under fair surface drainage and poor internal drainage are classified in the Lenoir, Moyock, and Dragston series. This degree of development is illustrated by Lenoir silt loam. A sample of this type, studied 3 miles south of Virginia Beach, is described as follows:

$A_{2\,1}$. 0 to 3 inches, gray to dark-gray or grayish-brown silt loam; root channels dark gray, giving appearance of mottling. (About ½ inch of nearly black silt loam with high content of organic matter A_1 on the surface was not sampled.) pH 4.5.

$A_{2\,2}$. 3 to 8 inches, mottled gray and grayish-brown silt loam. pH 4.4.

B. 8 to 19 inches, mottled brownish-yellow, rust-brown, and gray clay, breaking into irregular angular aggregates about ¼ inch on a side. Many of these aggregates are coated with gray or yellowish-gray silt and the interiors are rust brown. pH 4.6.

C. 19 to 30 inches, stiff plastic gray clay mottled with yellowish brown. pH 4.5.

The A and B horizons of these soils show some evidence of eluviation and illuviation, but not to the extent of the better drained soils. The B horizons are mottled, at least in the lower part, and the C horizons are very highly mottled gray, grayish yellow, and rust brown. The other members of this group are distinguished by the texture of the B and C horizons. Moyock soils are lighter textured in the B horizon than either Lenoir or Dragston and are lighter than Lenoir but heavier than

Dragston in the C horizon. Dragston soils are lighter than Lenoir in both the B and C horizons and have heavier B but sandier C horizons than Moyock.

The soils developed under very poor drainage are classified in the Bladen, Elkton, Fallsington, Bayboro, Portsmouth, and Hyde series. Of these, the first two have gray surface and subsoils and the others black surface and gray subsoils. The light-colored members of this group are illustrated by an example of Bladen silt loam studied half a mile northwest of Sigma.

1. 0 to 1 inch, dark-gray to gray heavy silt loam. In many places this horizon is 3 or 4 inches thick and also in many places it is very silty. pH 4.0.
2. 1 to 16 inches, gray sticky soft silty clay loam to clay. In many places this horizon is mottled with grayish yellow and is very silty.
3. 16 to 30 inches, mottled gray, grayish-yellow, and rust-brown stiff plastic clay or silty clay loam.

The mechanical analysis of a representative profile of Bladen silt loam is given in table 14.

TABLE 14.—*Mechanical analysis of Bladen silt loam*

Sample No.	Depth	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
	Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
213040	0–1	0.2	0.4	1.2	3.7	3.7	71.4	19.4
213041	1–16	0	.2	.7	2.6	2.3	61.6	32.6
213042	16–30+	0	.2	.8	2.9	2.5	63.5	30.1

Elkton soils are distinguished from Bladen soils on the basis of a sandy substratum and by layers or lenses of sand throughout the soils. Also, in most places Elkton soils have a soft sandy clay or clay loam subsoil. Fallsington soils have sandy surface soils and substrata. Bayboro soils resemble Bladen in subsoil characteristics but have a dark-gray to black surface soil that extends to a depth of 12 to 18 inches. Portsmouth soils have a very dark-gray to black surface soil to a depth of 12 to 18 inches, gray or mottled gray, grayish-yellow, and rust-brown soft sandy subsoil and mottled gray, grayish-yellow, and rust-brown sandy clay or clayey sand substratum. Hyde soils have a very dark-gray to black mucky surface soil to a depth of 10 to 15 inches, very dark-gray stiff clay or clay loam subsoil to 20 to 30 inches and a steel- or bluish-gray clay substratum.

Another way in which these soils may be studied is by grouping the soil series in catenas, or groups of soils developed under the same climatic conditions, under different drainage conditions, but from similar parent materials. These catenas or groups are given the name of the best developed or zonal soils, which are the Sassafras, Norfolk, and Craven.

The Sassafras catena includes all members of the Sassafras, Woodstown, Dragston, and Fallsington series. These soils have developed from similar parent materials but under conditions of drainage that range from good to very poor. Relief has also played an important part in the development of the normal soil profiles. All soils in the Sassafras catena are characterized by a light-textured C horizon consisting mainly of sands, light sandy loams, and gravel more or less intermixed.

The Norfolk catena is not so well developed in Princess Anne County as farther south, where the Norfolk and associated soils predominate in certain localities. In this county the Norfolk, Moyock, and Portsmouth soils may be considered in the Norfolk catena, as they have sandy clay C horizons of slightly heavier texture than in the Sassafras catena.

Those soils in the county that have heavy silty clays or clays in the B horizon and heavy clays in the C horizon have, for the sake of convenience, been placed in the Craven catena. These include the Craven, Lenoir, Bladen, Elkton, Bayboro, and Hyde. They occupy flat or almost level relief for the most part, and except for the Craven all are imperfectly to poorly drained, none has a normally developed profile, and all are underlain by beds of heavy clays.

The groups of miscellaneous land types, or classifications of material, are not definite soil types. Some areas of the tidal marsh are incipient stages of Bladen soils.

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SOIL SURVEY OF PRINCESS ANNE COUNTY, VIRGINIA

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United States Department of Agriculture in cooperation with the Virginia Agricultural Experiment Station

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SUMMARY

Princess Anne County, occupying the eastern part of the mainland of Virginia, lies between Norfolk and the Atlantic Ocean and includes the well-known Virginia Beach resort. Except for some hilly areas of dune sand near Cape Henry, which reach an elevation of almost 100 feet, the surface relief of its 270 square miles ranges from nearly level to very gently undulating. Only about 20 percent of the soil is naturally well drained. Considerable areas of the flat almost level soils have been artificially drained by canals, supplemented by small open lateral ditches.

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The climate is mild and rainfall is abundant and well distributed throughout the year. Summer heat is tempered by breezes from the ocean. The frost-free season is long, and many hardy truck crops can be grown in winter.

Explorers who established the first permanent English settlement at Jamestown landed first at Cape Henry in April 1607 to reconnoiter and obtain water. The first settlement in the county, near the mouth of Lynnhaven Bay, was not made until 1621. About 30 percent of the land area is cultivated, principally for a variety of truck crops, potatoes, sweetpotatoes, strawberries, corn, and soybeans. Dairying is practiced to some extent, and the products are sold on the Norfolk market.

The soils are mapped as 24 types and phases in 4 groups, according to drainage conditions, and 10 separations classed as miscellaneous land types.

The well-drained soils include the Sassafras, Woodstown, Norfolk, and Craven series. The first two of these soils are similar in characteristics to some of those on the eastern shore of Virginia and Maryland, whereas the last two are representative of the seaward part of North Carolina. Most of the truck crops, vegetables, and strawberries are grown on these soils, which have a wide crop adaptation and when properly fertilized and managed produce good yields.

The soils of the Lenoir, Moyock, and Dragston series comprise the imperfectly drained group. Though not so well drained as those of the first group, in many places they occur in close association with them. Some vegetables and truck crops, especially potatoes, are produced, but these soils are better adapted to growing corn, soybeans, and other staple crops. Artificial drainage is required to obtain the best yields and to render these soils suitable for growing a wide variety of crops.

The light-colored poorly drained soils include the Bladen, Elkton, and Fallsington series. Bladen silt loam occurs in large continuous areas and has a flat almost level surface. As these soils are poorly drained, all require artificial drainage for agricultural purposes. The principal crops are corn and soybeans, but some potatoes and strawberries are produced.

The dark-colored poorly drained soils, of the Bayboro, Portsmouth, and Hyde series, have a high content of well-decomposed and disseminated organic matter. All are very poorly drained, but when artificially drained and limed they produce large yields of corn and soybeans and in some places good yields of potatoes. Inherently they are good strong soils.

The miscellaneous land types—coastal beach, dune sand and its stabilized phase, tidal marsh, marsh, swamp, swamp-dune sand complex, Arzell sand, pits, and made land—are mainly classification of material and not definite soil types. At present they are practically nonagricultural except for furnishing scant grazing to cattle and for small quantities of firewood. The sands are used largely for home sites, whereas the marshes and swamps are used to some extent as wildlife refuges.

Large areas of potentially fertile soil could be reclaimed for agricultural purposes by artificial drainage and made to produce good yields of corn, soybeans, potatoes, truck crops, and pasture grasses.

The soils are acid to extremely acid and are benefited by the application of lime. Soils that are particularly well drained and the lighter textured ones that have good physical qualities respond readily to commercial fertilizer. By reason of its soils, favorable climate, and good location with respect to transportation to northern markets, the county offers possibilities for future agricultural development.

GENERAL NATURE OF THE AREA

LOCATION AND EXTENT

Princess Anne County is a roughly rectangular area in the extreme southeastern part of Virginia (fig. 1). The northern edge extends

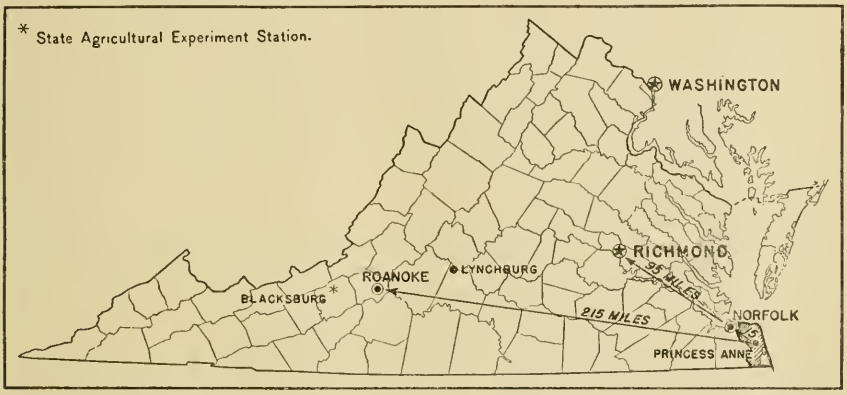


FIGURE 1.—Location of Princess Anne County in Virginia.

along Chesapeake Bay about 14 miles, and the eastern edge along the Atlantic Ocean from Cape Henry to the Virginia-North Carolina State line, about 25 miles. The total area is 270 square miles, or 172,800 acres. Virginia Beach, a well-known ocean resort and the largest town, is 18 miles southeast of Norfolk.

PHYSIOGRAPHY, RELIEF, AND DRAINAGE

Princess Anne County lies in the Coastal Plain physiographic division of the United States and in the Tidewater section of Virginia. It occupies a nearly level plain that in Virginia is divided into the Princess Anne and the Dismal Swamp terraces, both of which are of marine origin and of gently undulating to level relief. No fluvial deposits have been recognized within the county.[1] The Princess Anne terrace, ranging in elevation from sea level to about 15 feet, borders the ocean and Chesapeake Bay; and the Dismal Swamp terrace, with a maximum elevation of about 25 feet, covers the central and western parts of the county. These terraces are separated by a low escarpment that is almost imperceptible in most places but can be seen clearly just north of Beech Grove, where there is a distinct rise of about 5 feet.

[1] WENTWORTH, C. K. SAND AND GRAVEL RESOURCES OF THE COASTAL PLAIN OF VIRGINIA. Va. Geol. Survey Bul. 32, 147 pp., illus. 1930.

Dissection is neither complete nor thorough, and many large areas have no natural surface drainage. Most of the natural drainageways reach sea level within a few miles of their source, and no part of the county is more than 8 miles from a point that lies at sea level. Apparently the land is sinking slowly. Drainage in the northern part is effected through Lynnhaven Bay, the Eastern Branch Elizabeth River, and Little Creek, which flow into Chesapeake Bay; and in the southern part through North Landing River and Back Bay, which are tributary to Currituck Sound. A few square miles in the extreme southwestern part drain through the Northwest River, also tributary to Currituck Sound, and a small area in the vicinity of Virginia Beach drains directly into the Atlantic Ocean through Rudy Inlet. This is the only break in the coast line between the mouth of Lynnhaven Bay (Lynnhaven Inlet) on Chesapeake Bay and Oregon Inlet in North Carolina, a distance of about 100 miles. Back Bay, famous for waterfowl hunting, is a shallow fresh-water or very slightly brackish lake with marshy borders, comprising about 50 square miles in the southeastern part of the county. It is separated from the ocean by a narrow ridge of beach and dune sand and receives salt water during very severe storms. This is the site of the Federal Back Bay Migratory Bird Refuge.

Although the average elevation is about 20 feet, some of the sand dunes in the vicinity of Cape Henry reach a height of almost 100 feet. Local variations in elevation are slight, and there are nearly level areas, broken only by slight depressions, hummocks, and ridges, where the variation is less than 5 feet over a stretch of several square miles. The greatest local variations, other than the sand dunes, which are characterized by hilly relief, occur along Lynnhaven Bay, where many of the precipitous or overhanging banks are 20 to 25 feet high.

CLIMATE

The climate of Princess Anne County is oceanic; that is, it is moderated by the proximity of the Atlantic Ocean and Chesapeake Bay. The summers are long and temperate, but there are a few very hot days; the winters are mild, with very few days below freezing. Hardy crops, as spinach, kale, collards, turnips, turnip greens, and cabbage, are grown throughout the winter, and tender crops can be safely planted the first of April. The average frost-free season is 225 days (April 1 to November 11) at Diamond Springs, and 245 days (March 20 to November 20) at Cape Henry. Rainfall is adequate and well distributed throughout the year, and long periods of drought seldom occur. Wind velocities of 30 miles an hour are not uncommon, but these do little or no damage. Small areas along the coast are inundated with salt water during the infrequent but very severe northeast storms. Destructive wind, hail, or ice storms are almost unknown, as this section lies far enough south to escape the severe winters of northern United States and far enough north to escape the tropical storms of the Gulf States.

The normal monthly, seasonal, and annual temperature and precipitation at Diamond Springs and Cape Henry are given in table 1. These data are representative of the county as a whole.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at two stations in Princess Anne County, Va.*[1]

DIAMOND SPRINGS, ELEVATION, 25 FEET

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total for the driest year	Total for the wettest year	Average snowfall
	°F.	°F.	°F.	Inches	Inches	Inches	Inches
December	44.3	80	9	4.15	4.54	5.23	1.2
January	43.3	79	2	3.54	4.15	2.22	2.5
February	43.7	90	5	3.34	2.30	3.93	1.2
Winter	43.8	90	2	11.03	10.99	11.38	4.9
March	49.8	91	14	3.62	2.60	3.22	2.2
April	57.8	96	23	3.27	2.98	4.35	(2)
May	65.8	96	35	4.15	2.13	10.35	0
Spring	57.8	96	14	11.04	7.71	17.92	2.2
June	73.7	99	44	5.11	4.82	8.35	0
July	77.6	102	51	5.54	2.70	6.25	0
August	76.6	103	51	4.28	1.69	7.25	0
Summer	76.0	103	44	14.93	9.21	21.85	0
September	72.4	97	42	3.71	2.30	9.71	0
October	62.7	94	28	2.94	2.40	.35	0
November	52.2	85	15	2.36	1.05	2.70	(2)
Fall	62.4	97	15	9.01	5.75	12.76	(2)
Year	60.0	[3] 103	[4] 2	46.01	[5] 33.66	[6] 63.91	7.1

CAPE HENRY, ELEVATION, 16 FEET

December	43.7	78	7	3.44	1.35	5.28	1.5
January	40.2	79	6	3.15	4.39	5.59	2.0
February	41.2	84	5	3.31	1.29	1.06	2.3
Winter	41.7	84	5	9.90	7.03	11.93	5.8
March	46.6	90	12	3.87	1.02	6.29	1.3
April	54.6	97	26	3.30	.93	6.89	(2)
May	64.2	98	41	3.57	3.30	2.88	0
Spring	55.1	98	12	10.74	5.25	16.06	1.3
June	72.9	102	48	3.96	3.14	4.61	0
July	77.5	102	55	5.37	2.57	6.48	0
August	76.9	103	57	4.86	1.21	3.32	0
Summer	75.8	103	48	14.19	6.92	14.41	0
September	71.8	99	47	2.86	.46	10.04	0
October	62.1	92	35	3.01	2.73	6.79	0
November	52.1	86	19	2.36	.83	5.44	(2)
Fall	62.0	99	19	8.23	4.02	22.27	(2)
Year	58.7	[7] 103	[8] 5	43.06	[9] 23.22	[10] 64.67	7.1

[1] Records from U. S. Weather Bureau.
[2] Trace.
[3] August 1917.
[4] January 1918.
[5] In 1930.
[6] In 1924.
[7] August 1881.
[8] February 1889.
[9] In 1915.
[10] In 1877.

VEGETATION

Originally this area was densely wooded, probably with the same species of trees as are growing today. The forests have been largely cut over one or more times, but about 94,000 acres, a little more than half the total area of the county, are still in forest. Loblolly pine

is the most common tree, and in many places an even-aged pure stand develops in abandoned fields on both well-drained and imperfectly drained situations. Red oak, white oak, hickory, and holly are found in old forests on well-drained areas; beech, sycamore, sweetgum, black tupelo, yellow poplar, and red maple are common on the wetter areas; and cypress is in swamps. Most areas have a thick undergrowth of gallberry, waxmyrtle, greenbrier, blackberry, wild grape, and, in poorly drained places, cane or reeds. The tidal and fresh-water marshes support a dense growth of coarse reedy grasses, the species differing in the two types. Cattails are common in the latter.

Following is a list of the more important trees and plants of the county:

Acer rubrum L.	Red maple.
Arundinaria tecta (Walt.) Muhl.	Cane.
Carya glabra (Mill.) Sweet (*Hicoria glabra*)	Pignut hickory.
Cornus florida L.	Dogwood.
Fagus grandifolia Ehrh.	Beech.
Ilex glabra (L.) A. Gray	Gallberry.
I. opaca Ait.	Holly.
Liquidambar styraciflua L.	Sweetgum.
Liriodendron tulipifera L.	Yellow poplar.
Myrica cerifera L. (*M. caroliniensis*)	Waxmyrtle.
Nyssa sylvatica Marsh.	Black tupelo; sour gum.
Platanus occidentalis L.	Sycamore.
Pinus taeda L.	Loblolly pine.
Quercus alba L.	White oak.
Q. falcata Michx. (*Q. rubra*)	Red oak.
Rubus allegheniensis Porter (*R. nigrobaccus*)	Blackberry.
Smilax sp.	Greenbrier.
Taxodium distichum (L.) Rich.	Cypress.
Typha latifolia L.	Cattail.
Vitis riparia Michx.	Wild grape.
Zanthoxylum americanum Mill.	Prickly-ash.

ORGANIZATION AND POPULATION

It was at Cape Henry, on April 26, 1607, that the settlers who later established the first permanent English settlement at Jamestown first set foot on American soil, to reconnoiter and obtain water. The first settlement in what is now Princess Anne County was made in 1621, when Adam Thoroughgood established a home near the mouth of Lynnhaven Bay. Later, about 1640, he built a brick house, which is still standing and is said to be the oldest residence in Virginia.

Princess Anne County was formed from lower Norfolk County in 1691 and the present boundary was established in 1921. Prior to the Revolutionary War, both Lynnhaven (a town near the mouth of Lynnhaven Bay, not the site of the present village of that name) and Kempsville were important ports of entry. The first agricultural fair in Virginia is said to have been held at Kempsville in 1852. The first court was held at Lynnhaven in 1637. The county seat was later (1692) moved to the vicinity of Old Donation Church, then (1751) to Newtown on the Eastern Branch Elizabeth River (about 2 miles west of the present town of Kempsville), then (1778) to Kemps Landing (now Kempsville), and finally (in 1824) to Princess Anne. the present site in the center of the county.[2]

[2] WHITE, B. D. GLEANINGS IN THE HISTORY OF PRINCESS ANNE COUNTY. 19 pp. 1924. Norfolk, Va.

The early settlers came from England, and there was some influx from North Carolina and other parts of Virginia. Recently several Mennonite families from Pennsylvania and Ohio have settled in the vicinity of Kempsville.

According to the 1940 census, native-born whites constitute 60.1 percent of the population and Negroes (native-born descendants of former slaves) 38.8 percent. The total population, all classed as rural, is 19,984. Virginia Beach (population 2,600) is the largest town, and other villages, all of which have less than 1,000 inhabitants, are Oceana, Londonbridge, Lynnhaven, East Ocean View, Princess Anne, Kempsville, Pungo, and Creeds. All except East Ocean View are important locally as trading centers and concentration points for farm produce.

Elementary schools are centrally located, and transportation is furnished all pupils who live some distance from them. High schools are maintained at Creeds, Oceana, Kempsville, and Euclid. Many rural churches have been abandoned and many farmers must travel to Norfolk or Virginia Beach to attend services.

The Virginia Truck Experiment Station is located at Diamond Springs (pl. 1), but its post-office address is Norfolk, Va. The Farm Bureau has recently been organized to promote the social and economic welfare of rural residents. Telephones and electricity for lighting and power are available to most farms.

INDUSTRIES

There are no large industries within the county, but many men find part- or full-time employment in fishing, oystering, and crabbing. The oysters from Lynnhaven Bay are famous for size and quality. Lumbering furnishes full-time employment to many loggers and part-time employment to many farmers. As most of the timber is sawed in portable mills, there are no large sawmills. Brickyards are at Oceana and Lynnhaven.

TRANSPORTATION AND MARKETS

Hard-surfaced roads reach all parts of the county, and earth roads are well maintained. Norfolk, important for its seaport and railhead, is easily accessible by car or truck from all parts during all seasons. A passenger and vehicle ferry, capable of carrying the largest trucks, operates between Little Creek and Cape Charles on the Eastern Shore and materially shortens the time required to reach markets in Philadelphia and New York. The Norfolk Southern Railroad reaches all towns in the county, and the Pennsylvania Railroad crosses the northwestern part to its ferry dock at Little Creek, where cars are ferried to Cape Charles. In addition to that shipped by rail, much produce is shipped by truck to Washington, Baltimore, Philadelphia, New York, and other northern markets, most of which can be reached by truck in less than 14 hours. The Chesapeake and Albemarle Canal, part of the Intracoastal Waterway, passes through this county.

Most of the milk produced in the county is sold in bottles in Norfolk. Many of the swine raised are sold in Richmond or Baltimore, but some farmers keep only breeding stock, and ship young pigs to other parts of Virginia.

AGRICULTURE

Agriculture in Princess Anne County began at a very early date, as the Indians were growing corn when white men arrived early in the seventeenth century. From the standpoint of acreage, corn has continued to be the most important crop for more than 300 years. The early settlers occupied the well-drained sandy land bordering Lynnhaven Bay, the Eastern Branch Elizabeth River, Back Bay, and the ridge, now known as Pungo Ridge, which traverses the central part of the county. Many houses are standing today that were built before the Revolutionary War.[3] Settlement continued into the less well-drained parts of the county as open drainage ditches were dug.

Early agriculture consisted of raising corn, wheat, and livestock for subsistence and tobacco as a cash crop. In recent years the growing of vegetables (potatoes, sweetpotatoes, and green vegetables) and strawberries and dairying have received special emphasis. The acreage in potatoes increased from 3,643 to 4,040 between 1929 and 1939 and they became the most important cash crop. Rapid transportation, which allows succulent vegetables to be shipped to distant markets, was responsible for the increase of vegetable production, and the growth of the city of Norfolk was responsible for the increase in dairying. Dairying is also receiving increasing emphasis, as the number of cows 2 years old and older increased from 2,042 to 2,439 during the same period. The most popular breeds of dairy cattle are Guernsey and Holstein-Friesian.

The important trends in recent agriculture are shown in tables 2 and 3.

TABLE 2.—*Number and value of farms, and area and improved land in farms in Princess Anne County, Va., in stated years*

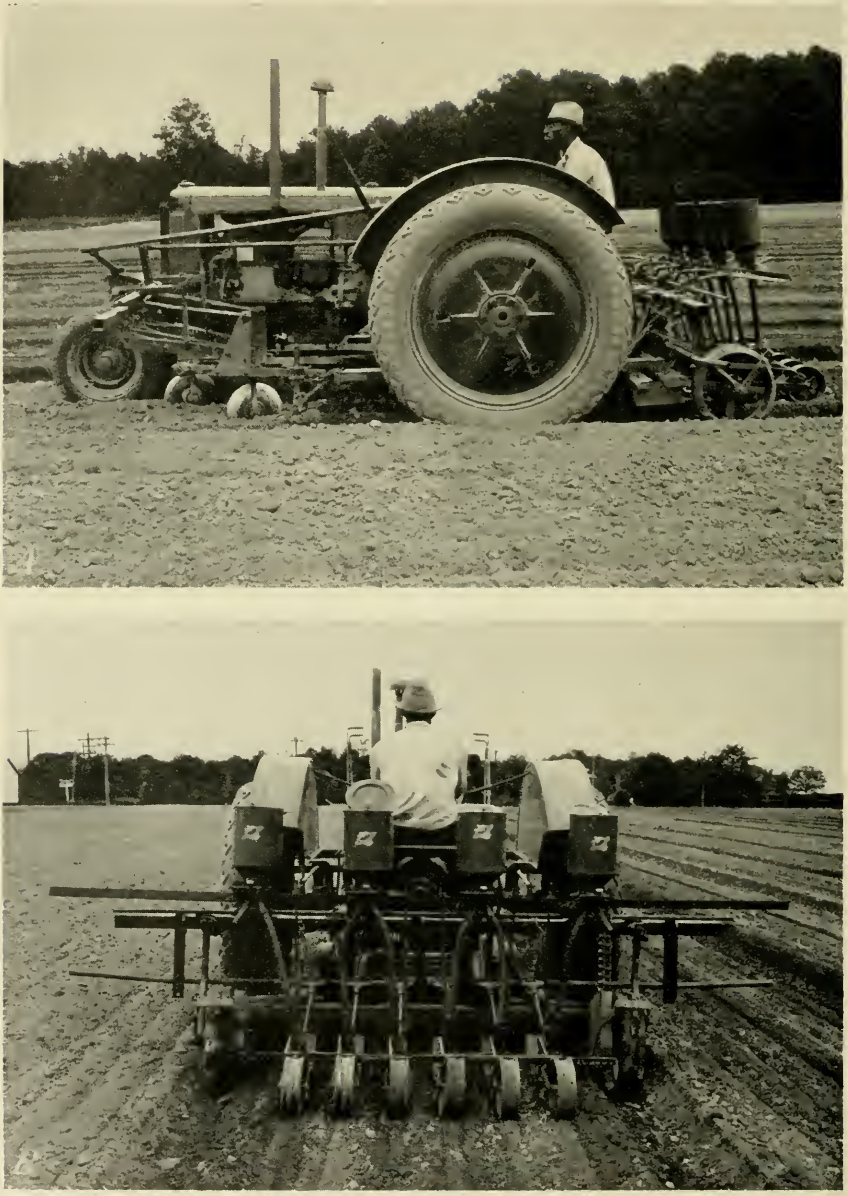
Year	Farms	Average size of farms	Land in farms		Improved land			Value of land and buildings	
					Total	Per farm		Per farm	Per acre
	Number	*Acres*	*Acres*	*Percent*	*Acres*	*Acres*	*Percent*	*Dollars*	*Dollars*
1880	917	123.0	112,493	63.0	50,648	55.2	45.0	1,506	12.28
1890	900	129.0	115,661	64.8	62,231	69.1	53.8	2,197	17.10
1900	1,432	82.8	118,529	66.4	71,029	49.6	59.9	1,672	20.20
1910	1,423	71.8	102,120	57.2	63,232	44.4	61.9	2,919	40.68
1920	1,317	71.8	94,544	52.9	60,325	45.8	63.8	6,008	83.69
1930	1,180	76.3	90,050	49.4	55,718	47.2	60.1	7,736	101.37
1940	939	93.3	87,597	51.3	53,312	56.8	60.2	6,220	66.68

TABLE 3.—*Acreage of principal crops in Princess Anne County, Va., in stated years*

Crop	1879	1889	1899	1909	1919	1929	1939
Corn:	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*
Harvested for grain	28,573	25,647	32,718	34,192	31,714	20,283	15,506
For other purposes					1,380	1,002	1,227
Wheat	109	3		30	497	181	413
Barley		2				23	305
Rye	15	94	12	10		35	415
Oats:							
Threshed	1,138	876	816	32	297	232	634
Cut and fed unthreshed						248	142

[3] KELLAM, S. S., and KELLAM, V. H. OLD HOUSES IN PRINCESS ANNE, VIRGINIA. 235 pp., illus. 1931. Portsmouth, Va.

A, Office building and greenhouses of the Virginia Truck Experiment Station, at Diamond Springs. Woodstown silt loam in foreground. *B*, Early spring celery growing at the experiment station on Woodstown silt loam under sash.



A, Side view of tractor, showing planting attachments for spinach. Disks in front of tractor throw up beds, meeker directly behind wheels smooths bed, and 6-row gang planter plants the seeds. With this equipment, one man can prepare the beds and plant 20 acres of spinach a day. *B*, Rear view of spinach planter.

TABLE 3.—*Acreage of principal crops in Princess Anne County, Va., in stated years*—Continued

Crop	1879	1889	1899	1909	1919	1929	1939
	Acres	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*
Hay	510	2,560	3,261	2,421	4,476	[1] 6,043	[1] 5,888
Annual legumes					3,581	4,289	4,213
Alfalfa			4	25	118	227	464
Timothy and clover, alone or mixed				743	125	126	195
Clover alone			119	75	26	98	648
Small grain hay			223	272	306	953	187
Other tame hay			2,915	1,174	295	255	94
Wild hay				132	25	80	15
Soybeans, total					1,518	5,008	14,185
Harvested for beans only							9,841
Cotton		5	185	128	215	2,188	35
Potatoes		828	2,170	2,905	3,654	3,643	4,040
Sweetpotatoes and yams	685	1,027	1,123	1,148	1,824	1,175	1,376
Market vegetables						6,824	8,388
Strawberries			1,617	1,281	332	1,234	1,139

[1] Includes 15 acres of sorghums cut for silage, hay, or fodder in 1929, and 72 acres in 1939.

Most farmers have chickens, and many, especially in the vicinity of Pungo, raise turkeys. The 1940 census reports 55,206 chickens and 977 turkeys over 4 months old. There were 6,607 hogs and pigs over 4 months of age. Many hogs are fed garbage hauled from Norfolk.

The value of agricultural products sold or traded by farm households in 1939 is shown below.

	Value
Livestock sold or traded [1]	$96,899
Livestock products sold or traded	540,028
Dairy products	389,871
Poultry and poultry products	137,934
Other livestock products	12,223
Crops sold or traded	1,399,858
Field crops [2]	685,672
Vegetables harvested for sale [3]	561,202
Fruits and nuts	134,096
Horticultural specialties sold	18,888
Forest products sold	15,388
Total cash farm income	2,052,173

[1] Exclusive of poultry, bees, and fur animals.
[2] Including potatoes and sweetpotatoes.
[3] Exclusive of potatoes and sweetpotatoes.

Labor is the largest item of expense on many farms, especially those on which vegetables are grown, the total expenditure in 1939 on 525 farms being $431,002, or an average of $820.96. The larger farms employ permanent hands, who live on the farm and receive rent, fuel, milk, and produce as part of their remuneration. Much of the seasonal labor is performed by Negroes (mostly women) who live in Norfolk. They are hired by the day for most operations and transported in trucks, but most specialized work, such as thinning and harvesting spinach and picking strawberries, is paid on piece-work basis. This type of labor has been plentiful and efficient, and it is not uncommon to see 100 or more hands in a 20-acre field cutting green vegetables.

Fertilizer is used extensively. The average expenditure on 635 farms in 1939 was $512.36. Very heavy applications, frequently a ton an acre, of ready-mixed complete fertilizer are added to the soils used

for potatoes and green vegetables, and many crops are side-dressed with a nitrogen salt. Most of the fertilizer, with the exception of nitrogen salts, is prepared in Norfolk, where there are several plants. Lime is extensively used, especially on truck farms. In 1939, 3,871 tons of liming materials were used on 233 farms. In the same year, 600 farms reported an average expenditure of $267.09 for the purchase of feed. Most of this is concentrates bought ready-mixed and used to supplement feed grown on the farm, but some roughage is purchased from nearby farms.

A few farms, or about 0.9 percent, are operated by managers; 711, or about three-fourths, by owners; and the rest, 220, or 23.4 percent, by tenants. Many of the potato growers practice a system of owner-share-cropping, whereby an individual or firm supplies the seed, fertilizer, and spray material, and the owner the land and labor. When the crop is harvested and sold, the cost of seed, fertilizer, spray, transportation, and selling is deducted before the farmer receives his share.

Most of the farmhouses maintained by owners are substantial and in good repair, but tenant houses are generally small and many are in poor condition. Many farms have barns sufficiently large to shelter livestock and store hay and grain, and also outbuildings for storing machinery. Much of the land, especially on truck farms, is prepared by large tractors. Soybeans are harvested with combines.

SOIL SURVEY METHODS AND DEFINITIONS

Soil surveying consists of the examination, classification, and mapping of soils in the field and the recording of their characteristics, particularly in regard to the growth of various crops, grasses, and trees.

The soils and the underlying formations are examined systematically in many locations. Test pits are dug, borings are made, and road or railroad cuts, and other exposures, are studied. Each excavation exposes a series of distinct soil layers, or horizons, termed collectively the soil profile. Each horizon, as well as the underlying parent material, is studied in detail, and the color, structure, porosity, consistence, texture, and content of organic matter, roots, gravel, and stone are noted. The reaction of the soil and its content of lime and salts are determined by simple tests.[4] The drainage, both internal and external, and other external features, as the relief or lay of the land, are taken into consideration, and the interrelation of the soil and vegetation is studied.

The soils are classified according to their characteristics, both internal and external, with special emphasis upon features that influence the adaptation of the land for the production of crop plants, grasses, and trees. On the basis of these characteristics the soils are grouped into classification units, the three principal ones of which are (1) series, (2) type, and (3) phase. In some places two or more of these units may be in such intimate or mixed pattern that they cannot be clearly shown separately on a small-scale map but must be mapped as (4) a

[4] The reaction of the soil is its degree of acidity or alkalinity, expressed mathematically as the pH value. A pH value of 7 indicates precise neutrality; higher values, alkalinity; and lower values, acidity. Indicator solutions are used to determine the reaction. The presence of lime is detected by the use of a dilute solution of hydrochloric acid.

complex. Some areas that have no true soil—as coastal beach, dune sand, and tidal marsh—are termed (5) miscellaneous land types.

The series is a group of soils having the same genetic horizons, similar in their important characteristics and arrangement in the soil profile and having similar parent material. Thus, the series comprises soils having essentially the same color, structure, natural drainage, and other important internal characteristics and the same range in relief. The texture of the upper part of the soil, including that commonly plowed, may vary within a series. The series are given geographic names taken from localities near which they were first identified. Sassafras, Woodstown, Bladen, Dragston, Lenoir, and Elkton are the names of important soil series in Princess Anne County.

Within a soil series are one or more types, defined according to the texture of the upper part of the soil. Thus, the class name of this texture, as sand, loamy sand, sandy loam, silt loam, clay loam, silty clay loam, or clay, is added to the series name to give the complete name of the soil type. For example, Sassafras fine sandy loam and Sassafras silt loam are soil types within the Sassafras series. Except for the texture of the surface soil, these types have approximately the same internal and external characteristics. The soil type is the principal unit of mapping, and because of its specific character it is usually the unit to which agronomic data are definitely related.

A soil phase is a variation within the type, differing from it in some minor feature, generally external, that may be of special practical significance. For example, within the normal range of relief of a soil type some areas may be adapted to the use of machinery and the growth of cultivated crops and others may not. Differences in relief, stoniness, and degree of accelerated erosion may be shown as phases. Even though no important differences may be apparent in the soil itself or in its capability for the growth of native vegetation throughout the range in relief, there may be important differences in respect to the growth of cultivated crops. In such instance the more sloping parts of the soil type may be segregated on the map as a sloping or a hilly phase. Similarly, some soils having differences in stoniness may be mapped as phases, even though these differences are not reflected in the character of the soil or in the growth of native plants.

The soil surveyor makes a map of the county or area, showing the location of each of the soil types, phases, complexes, and miscellaneous land types, in relation to roads, houses, streams, lakes, and other local cultural and natural features of the landscape.

SOILS

Princess Anne County, in the Tidewater section of Virginia, has a variety of soils and diverse drainage conditions. Most of the county resembles other parts of the Tidewater section of Virginia and North Carolina, but the northwestern part is similar to the Eastern Shore section.

Thirty-four soil separations are shown on the map. These include the soil types and phases and ten separations grouped as miscellaneous land types, the latter being dominantly nonagricultural. About 30 percent of the area is cultivated, 55 percent is in timber, 10 percent is

in marsh, and the remaining 5 percent is in dune sand and coastal beach. There is little permanent pasture other than woodland pasture.

The soils have developed from unconsolidated beds of sand, silt, and clay and differ widely in texture, structure, consistence, and color, as well as in chemical composition. The color of soil and subsoil depends on the drainage conditions and on the quantity of organic matter present. Drainage is a very important factor in soil development, as it influences the aeration and oxidation of the iron in the materials from which the soils are derived. Lack of drainage accounts for the mottled condition of many of the subsoils. The differences in texture and structure of the various soils are largely the result of the character of the underlying material, whether sand, silt, or clay.

Table 4 summarizes the profiles of the soil series of Princess Anne County as to drainage, surface relief, color, subsoil consistence, and underlying materials. The miscellaneous land types are not included. Drainage refers to both external and internal conditions. The porosity of some of the soils and subsoils that are poorly drained is such that they would be fairly well drained were it not for the high water table.

TABLE 4.—*Key to the soils of Princess Anne County, Va.*

Soil series	Drainage	Surface relief	Color		Subsoil consistence	Materials underlying subsoil
			Surface soil	Subsoil		
Sassafras	Good	Flat to undulating.	Light brown	Reddish brown	Friable	Friable sandy material.
Norfolk	do	Flat	Grayish yellow	Brownish yellow.	do	Fine sandy clay.
Woodstown.	Fair to good.	Nearly flat	Grayish brown	Yellowish brown	do	Sticky sand.
Craven	Fair	do	Grayish yellow	Brownish yellow.	Firm to dense.	Clay.
Lenoir	Imperfect	Flat	Yellowish gray	Mottled	Tough	Tough clay.
Moyock	do	do	Medium gray	do	Friable	Friable fine sandy clay.
Dragston	do	do	Gray	Grayish yellow	do	Clayey sand.
Bladen	Poor	Level	do	Mottled	Plastic	Plastic clay.
Elkton	do	do	do	do	do	Stratified sandy and clayey material.
Fallsington.	do	do	do	do	Sticky	Clayey sand.
Bayboro	do	do	Dark gray to black.	Bluish gray	Plastic	Plastic clay.
Portsmouth.	do	do	Black	Mottled	Friable	Friable sandy clay.
Hyde	do	do	do	Bluish gray	Plastic	Plastic clay.

Most of the well-drained soils, as Sassafras, Norfolk, Woodstown, and Craven, are in the northwestern part but they also occur in the south-central part of the county. The Sassafras, Norfolk, and Woodstown soils are brown to grayish yellow in the surface layer, reddish brown to yellowish brown in the friable subsoil, and are underlain by friable sandy material, which, together with the undulating or very gently sloping relief, has given them good to fair drainage. The Sassafras soils are richer in plant food nutrients than the Norfolk. The latter are generally well drained, but the material below the subsoil in Norfolk fine sandy loam is not so sandy as that under the Sassafras soils. The Craven soils have a grayish-yellow friable surface layer, brownish-yellow moderately friable subsoil, but compact silty clay loam or clay substrata. They have fair surface drainage, but

because of the heavy, relatively impervious character of the deeper layers, internal drainage is slow.

Scattered over the county are small to fair-sized areas of Lenoir, Moyock, Dragston, and Portsmouth soils. Lenoir occurs in close association with the Craven and Bladen, whereas the Dragston generally occupy an intermediate position between the Fallsington and the Woodstown or Sassafras soils. The Bladen soils occupy large areas in the central, western, and southwestern parts of the county. Associated with these are small- to fair-sized areas of Elkton, Bayboro, and Hyde. These soils have level to flat surfaces, are poorly drained throughout, and with the exception of the Elkton are underlain by heavy plastic clay. They constitute some of the potentially good agricultural soils of the county and where artificially drained they produce good yields of corn and soybeans. Except where lime has been applied, all the soils are acid to strongly acid. Lime is beneficial on all.

The present-day agriculture consists largely of succulent truck crops, as spinach, kale, collards, cabbage, snap beans, and radishes, strawberries, and sweetpotatoes on the better drained sandy soils in the northern part of the county; potatoes, English or garden peas, corn, and soybeans on the less well-drained sandy soils in the southern part; and corn and soybeans on the poorly drained heavy soils in the central part. These crops spread considerably over the different districts, and corn is grown on a larger acreage than any other crop. The truck crops, potatoes, and strawberries are shipped to northern markets the same day they are harvested. Some sweetpotatoes are stored in pits on the farm for home use and local sale, but there are several storage houses where they are cured and stored for later shipment. Most of the corn and soybeans are fed on the farm where produced. Corn generally matures and is shucked from stalks in the field, but some is cut for silage; soybeans are cut green and cured for hay, but those from many acres are allowed to mature, the beans are harvested by combine, and the plant residue is plowed under. For the most part threshed soybeans are sold as a cash crop, but a few are processed and the pulp used as feed. Some farmers turn hogs into the fields to feed on such beans as are shattered by the combines during harvest. Because the oil in the beans produces a very soft grade of pork, these hogs must be hardened on corn for 2 or 3 weeks before being marketed.

The relations between the crops grown and the soils is most easily explained by grouping the soils according to the characteristics that determine their capability for use. The most logical grouping in this county is on the basis of drainage, as follows: (1) Well-drained soils, (2) imperfectly drained soils, (3) light-colored poorly drained soils, (4) dark-colored poorly drained soils, and (5) miscellaneous land types. In places where the soils are drained artificially, they can be used for crops to which not naturally adapted. Many acres of the poorly drained Bladen, Elkton, and Portsmouth soils could thus be made to produce good yields.

WELL-DRAINED SOILS

The well-drained soils are in the Sassafras, Norfolk, Woodstown, and Craven series. The soils of this group are Sassafras fine sandy

loam, sandy loam, and silt loam; Norfolk fine sandy loam and loamy fine sand; Woodstown fine sandy loam, sandy loam, and silt loam; Craven silt loam and fine sandy loam. They comprise 30,272 acres, or 17.4 percent of the total area of the county. About 70 percent of this, or about 21,000 acres, is cultivated and makes up about two-fifths of the total area of improved land. The small area that is not cultivated consists largely of small inaccessible or isolated areas or of areas along the bays and inlets that have been left in timber to serve as windbreaks or to improve the shape of fields. Some large areas of the silt loams are not cultivated because the tendency to remain saturated during periods of heavy rainfall makes most of them unsuitable for winter crops. The vegetation consists of loblolly pine, red oak, white oak, some dogwood, hickory, and holly, with an underbrush of myrtle and briers.

These soils are most extensively developed in the northern part of the county and border the swamp along the North Landing River. The eastern bank of this swamp, known locally as Pungo Ridge, extends northward in a low, narrow, almost unbroken ridge to Broad Bay. A few small areas have developed on isolated low ridges or knolls in other parts of the county.

The first settlements and clearings were on these soils, and many areas have been cultivated for about 300 years. These nearly level soils are easily tilled, and all except the silt loams have a large percentage of sand in the surface layer. Artificial drainage is necessary in a few places, and most of the ditches drain adjoining or included less well-drained areas. The surface soils are grayish yellow or light brown. The greater part of the total area is fine sandy loam, but about 26.8 percent is silt loam, 8.9 percent sandy loam, and 1.3 percent loamy fine sand.

In most instances the subsoils are friable yellow or brownish-yellow clay loams, but that of the Sassafras series is reddish brown or yellowish brown and that of the Craven is rather stiff plastic clay or clay loam. The substrata of the Sassafras soils are reddish-brown loose sand and fine gravel, but the substrata of all the others are mottled gray, grayish yellow and rust brown, or brownish red. The Norfolk soils have sandy clay substrata; the Woodstown loose sand and gravel or loamy sand; and the Craven silty clay or interbedded clay, silt, and sand. Most of these soils have sufficient sand in the surface layers to absorb the average shower and sufficient clay in the subsoil to hold this moisture for plant growth. The silt loams are the only ones that remain saturated with water for any length of time, and most of them have been allowed to remain in timber.

The light color of the surface soils indicates a low content of organic matter. This is one of the limiting factors of plant growth, and is receiving careful attention from most farmers. These soils are leached of most of the soluble plant nutrients, but their physical properties are very favorable, and they respond readily to fertilization. Except in very wet periods they can be cultivated throughout the year, and they warm early in spring. These soils are medium to strongly acid, and lime must be used for the growth of most crops.

Most of the truck crops, strawberries, and sweetpotatoes are grown on these soils. Many areas of Norfolk and Sassafras fine sandy loams in the southern part of the county are used for potatoes, but green truck

crops could be extended to these areas if the demand for them should increase, or they should become more profitable than potatoes.

Spinach and potatoes are not generally grown in the same rotation, as the former requires a medium to very slightly acid soil for the best growth and the latter scabs badly at this degree of acidity.

In this group are the most highly valued soils in the county. Yields may not be higher than on many of the less well-drained soils, but crops mature earlier and in many seasons can be harvested when the price is high. In many instances crops are harvested before the maximum yield is reached in order to take advantage of high prices. A disadvantage of the sandier members of this group is that winter-grown crops must be harvested at maturity and cannot be held for a more favorable market so successfully as on the less well-drained areas.

Two crops of spinach, the first planted in September and harvested in November or December and the second planted in December or January and harvested in March or April, are grown on many areas. In some instances the second planting is seeded immediately after the first crop is harvested. Winter cabbage, which is transplanted from plant beds to the field in November and December can be grown only on well-drained soils. Kale and collards are planted in August or September and harvested from December through February. Two crops of snap beans can be harvested, the April planting in June and the August planting in September and October. Garden peas are planted in late February or early March and harvested in May. The quality of the strawberries produced is superior to that of those grown on the less well-drained soils, and winter heaving may reduce the stand on the poorly drained soils. The best yield of potatoes is obtained in wet seasons on the well-drained, but in dry years on the poorly drained soils. High-quality sweetpotatoes can be grown only on sandy well-drained soils, consequently all soils well suited to this crop are included in this group. Summer-grown truck crops have not been profitable in this district, therefore most areas are planted to green-manure crops or to corn or soybeans in summer. Some cucumbers and cantaloups, however, are grown for shipment, and tomatoes, beets, and watermelons for home use and local sale.

Much of the land, especially in the northern part of the county, is prepared and seeded by tractors. Some growers plow, harrow, and plant spinach in one operation by attaching the various machines in tandem. By this method one man can seed 20 acres of spinach in a day (pl. 2).

IMPERFECTLY DRAINED SOILS

The imperfectly drained soils comprise 20,928 acres, or 12.2 percent of the total area of the county. They include all the soils of the Lenoir, Moyock, and Dragston series. The soil types included are Lenoir silt loam and fine sandy loam, Moyock fine sandy loam, and Dragston fine sandy loam, sandy loam, and silt loam. All are comparatively light-colored in the surface layer and have mottled yellow and gray subsoils and gray or mottled gray and yellow substrata. They are found in all parts of the county, in most places in small individual areas separating the well-drained and poorly drained soils, but some extensive continuous bodies are found along shallow drainageways. All occur on nearly level relief, and in most places they occupy slight

depressions or broad flat areas a short distance from natural drainage channels. Some areas of the Lenoir soils and, to a lesser extent the Dragston, are at the head of drainageways and have fair to good surface drainage, but internal drainage is slow.

About half of these soils are cultivated and the rest support a dense growth of loblolly pine, red oak, black tupelo, hickory, beech, and yellow poplar and a dense underbrush of running brier, blackberry, gallberry, and myrtle. Every crop grown in the county, with the possible exception of sweetpotatoes, is produced on these soils, and most of the cultivated areas are utilized in the same manner as the other soils in the area in which they are found. Corn and soybeans are more extensively grown than on the better drained soils. Many areas can be cultivated without being artificially drained, but open ditches are beneficial on all areas. When adequately ditched, winter crops are grown successfully on many of these soils. They warm late in spring, and if February and March are abnormally wet, planting is delayed, but the growing season is long and crops can always mature, although cash crops may be too late to be profitable.

LIGHT-COLORED POORLY DRAINED SOILS

The light-colored poorly drained soils, the most extensive group, comprise 58,304 acres, or 33.7 percent of the area of the county. Included in this grouping are Bladen silt loam; silty clay loam, swamp phase; fine sandy loam; Elkton silt loam; and Fallsington fine sandy loam. These soils are extensive in all parts, and some areas of Bladen silt loam cover an area of several square miles. All the soils in the group have light-colored surface soils and gray or mottled gray and grayish-yellow subsoils. The subsoils of very stiff plastic clay, some of which have lenses of sand, are practically impenetrable to water. In their natural state these soils were permanently wet. Water stood on the surface for long periods, but open ditches have been dug, and now about 25 percent of the area is under cultivation.

Corn and soybeans are the principal crops, but a few acres are used for strawberries, green truck, and potatoes. Strawberries mature later and the fields become weedy, but the berries are of good quality and are cleaner than those grown on the better drained sandy soils. Truck crops are not grown in winter except in a very few places. Some oats, rye, and crimson clover are grown as soil-improving crops or for feed, but most cultivated areas remain bare. These soils warm slowly, and planting is sometimes delayed, but the growing season is sufficiently long to mature crops.

In forested areas the most common trees are loblolly pine, black tupelo, yellow poplar, red maple, hornbeam, and beech. There is always a thick underbrush, consisting largely of cane or reeds, blackberry, and running briers.

DARK-COLORED POORLY DRAINED SOILS

The dark-colored poorly drained soils are mapped on 13,696 acres, or 7.9 percent of the total area. They include Bayboro silt loam, Portsmouth loam, and Hyde silty clay loam. The very dark-gray to black surface soils have a high content of organic matter, and the subsoils are gray or gray mottled with grayish yellow. These soils occur in the

central and southern parts of the county, and in many places the individual areas contain 200 or 300 acres. They are located on flat relief, in most places at an elevation of less than 15 feet. Under natural conditions drainage is very poor. The water table stands at the surface most of the year, and during wet periods many areas are submerged. These conditions are favorable to the accumulation and retention of organic matter and are responsible for the characteristic dark-colored surface soils. About 20 percent of the total area has been artificially drained by open ditches and cultivated. Corn and soybeans are the principal crops, but potatoes are grown on some areas.

MISCELLANEOUS LAND TYPES

The miscellaneous land types and complex soil materials comprise 49,600 acres, or 28.8 percent of the total area of the county. This group includes coastal beach, dune sand and its stabilized phase, tidal marsh, marsh, swamp, swamp-dune sand complex, Arzell sand, pits, and made land. All are nonarable and none is suited to any purpose other than timber or home sites. Some areas provide scant pasture. The only feature that these separations have in common is their nonarable characteristics, as the material varies from pure sand to clay and peat, the drainage conditions from excessive to submerged, the elevation from sea level to about 100 feet (the highest point in the county), and the relief from flat to hilly.

DESCRIPTIONS OF SOIL UNITS

The soils of the county and their agricultural importance are described in detail in the following pages; their location and distribution are shown on the accompanying soil map; and their acreage and proportionate extent are given in table 5.

TABLE 5.—*Acreage and proportionate extent of the soils mapped in Princess Anne County, Va.*

Soil type	Acres	Percent	Soil type	Acres	Percent
Arzell sand	1,856	1.1	Made land	192	0.1
Bayboro silt loam	10,240	5.9	Marsh	17,536	10.2
Bladen fine sandy loam	640	.4	Moyock fine sandy loam	7,040	4.1
Bladen silt loam	36,480	21.1	Norfolk fine sandy loam	5,376	3.1
Bladen silty clay loam, swamp phase	3,968	2.3	Norfolk loamy fine sand	384	.2
Coastal beach	2,752	1.6	Pits	128	.1
Craven fine sandy loam	1,216	.7	Portsmouth loam	2,752	1.6
Craven silt loam	5,952	3.4	Sassafras fine sandy loam	8,960	5.2
Dragston fine sandy loam	2,048	1.2	Sassafras sandy loam	1,408	.8
Dragston sandy loam	512	.3	Sassafras silt loam	1,024	.6
Dragston silt loam	1,344	.8	Swamp	11,840	6.9
Dune sand	2,560	1.5	Swamp-dune sand complex	1,600	.9
Stabilized phase	5,568	3.2	Tidal marsh	5,568	3.2
Elkton silt loam	8,896	5.1	Woodstown fine sandy loam	3,520	2.0
Fallsington fine sandy loam	8,320	4.8	Woodstown sandy loam	1,280	.7
Hyde silty clay loam	704	.4	Woodstown silt loam	1,152	.7
Lenoir fine sandy loam	1,600	.9			
Lenoir silt loam	8,384	4.9	Total	172,800	100.0

Arzell sand.—This land type is found in narrow depressions between areas of dune sand or its stabilized phase, or in larger areas associated with these separations. It is most extensive on Cape Henry and east of Back Bay. The 2- or 3-inch surface layer is dark-gray loose

or loamy sand. The subsurface layer to a depth of 12 or 15 inches is gray to white quicksand underlain by a 5- or 6-inch layer of grayish-brown or mottled gray and brown quicksand that grades into white quicksand. In some places the surface and subsoil layers are fine sand. This type is extremely acid, is very poorly drained, and has water on the surface much of the year. It supports a sparse stand of loblolly pine, broomsedge, a coarse marsh grass, and various shrubs. Some areas provide scant pasture. This soil is mapped on 1,856 acres, or 1.1 percent of the total area of the county.

Bayboro silt loam.—The surface layer to a depth of about 10 inches is very dark-gray to black sticky silt loam when moist but becomes hard when dry. The subsoil to a depth of 20 or 24 inches is very dark-gray or bluish-gray sticky silt loam or stiff clay loam streaked with brown or rust brown. The subsoil and substratum are gray or mottled gray, grayish-yellow, and rust-brown tough plastic silty clay or interbedded fine sand, silt, and clay. The entire profile is extremely to very strongly acid. In a few places the surface soil is sandy loam or fine sandy loam, whereas in a few others it is silty clay loam.

Developed in very poorly drained sites from fine-grained marine deposits or interbedded sand, silt, and clay of marine origin, this soil is mapped on 10,240 acres, most extensively in the central part of the county. Many areas comprise several hundred acres. The relief is level or flat, and most areas are at a considerable distance from natural drainageways and are surrounded by poorly drained soils.

Artificial drainage, in most places open ditches, must be provided before the soil can be successfully cultivated. About 25 percent has been reclaimed and is cultivated. The uncultivated areas support a dense growth of black tupelo, loblolly pine, yellow poplar, sweetgum, red maple, and willow oak and a thick underbrush of cane or reeds and briers. Corn and soybeans are the principal crops, but potatoes are grown on about 10 percent of the cultivated area. Corn yields 40 bushels of grain or 8 to 10 tons of silage, soybeans 30 bushels of dry beans or 2 tons of hay, and potatoes 150 to 250 bushels an acre.

Corn and soybeans are grown on many farms without fertilization or with the addition of stable manure, but the best yields are obtained when 300 to 400 pounds of 4–12–4 [5] or 4–8–8 are used. On adequately drained areas yields of 50 bushels or more an acre of corn can be obtained. The land for potatoes receives 1,200 to 1,600 pounds of 6–8–6. Corn or soybeans are planted with no additional fertilization between the potato rows at the last cultivation or after the crop is harvested.

Bladen fine sandy loam.—In cultivated fields the 6- to 8-inch surface soil is gray to dark-gray fine sandy loam. The subsurface layer to a depth of 12 or 18 inches is light-gray slightly compact fine sandy clay, sticky when wet. The subsoil and substratum are light-gray or gray mottled with grayish-yellow and rust-brown tough plastic clay. The entire profile is extremely to very strongly acid. In a few places the surface soil is very fine sandy loam.

Developed at an elevation of about 15 feet from fine-grained marine deposits, this soil is mapped on 640 acres. The largest areas are in

[5] Percentages, respectively, of nitrogen, phosphoric acid, and potash.

the vicinity of Nimmo and Bonneys Corner, but a few small areas are found in other places in the southern part of the county. The relief is almost flat and both surface and internal drainage are very poor. About half of this soil is cultivated, chiefly to corn and soybeans. Corn yields 20 to 25 bushels an acre and soybeans 20 bushels of dry beans or 1½ tons of hay.

This soil must be drained before it can be cultivated. Open ditches are used for this purpose and stand up well, as the heavy clay subsoil does not slough. Some corn and soybeans are not fertilized, but in most places stable manure is applied before planting. A few farmers add 300 pounds an acre of 4–12–4 when planting these crops. This soil is more easily worked than the silt loam and it can be built up to a high state of productivity if properly drained and if the organic-matter content of the surface is maintained.

Bladen silt loam.—In cultivated fields the 6-inch surface soil is gray sticky heavy silt loam, becoming hard and nearly white when dry. The subsurface to a depth of 8 to 15 inches is light-gray sticky heavy silt loam or silty clay loam. The subsoil and substratum are gray or steel-gray very tough plastic clay or silty clay, mottled or streaked with grayish yellow and rust brown. The entire profile is extremely to very strongly acid.

In wooded areas the surface layer to a depth of 1 or 2 inches is dark-gray silt loam, high in organic matter. In some places, particularly in the vicinity of Rosemont and Lynnhaven, the surface soil and subsurface layer are very silty and the tough plastic clay is reached at a depth of 20 to 24 inches. In other places the subsurface layer is not found and the tough plastic silty clay is reached at a depth of 5 or 6 inches. Included with this soil is an area about 1 mile northwest of Blackwater School where the surface soil is stiff silty clay. In many places, especially in the northern part of the county, sandy clay is found at a depth of 4 feet or more. In a few places small pebbles are found on the surface and in the soil.

Developed from very fine-grained marine deposits, with an elevation of less than 15 feet, this type is extensive (36,480 acres), and large individual areas are found in all parts of the county except in the extreme northern part. The largest continuous areas are in the central part. The flat relief is broken only by very slight undulations and depressions. In many places the soil continues unchanged across these variations in elevation. It is possible within one area of this soil to draw a straight 5-mile line along which the elevation will not vary by more than 5 feet.

Although only about 25 percent of this soil is tilled, it is the most extensive cultivated type in the county. Corn and soybeans are the most common crops and occupy about 90 percent of the cultivated area. Some oats, clover, potatoes, strawberries, and green truck crops also are grown. Corn yields 20 to 25 bushels of grain or 6 tons of silage an acre, soybeans 15 to 20 bushels of dry beans or 1 to 1½ tons of hay, oats 20 to 25 bushels, clover 2 tons, potatoes 150 to 200 bushels, and strawberries and spinach 300 to 400 baskets. Several large dairies are on this soil, and permanent pastures are maintained, but in most places clover pasture is included in the rotation of corn, soybeans, and clover. The soil in the pastures becomes soft and miry in winter.

This soil cannot be cultivated unless artificially drained, but canals and open ditches serve very well and are easily maintained. The stiff clay subsoil does not slough, and good ditch banks or walls have been seen in areas left uncultivated 75 years or more. Some farmers do not fertilize corn and soybeans but apply stable manure or grow oats or clover as a green-manure crop, but in most cases 300 to 400 pounds an acre of 4–12–4 is applied for these crops. Oats and clover are not commonly fertilized, but 1,000 to 1,500 pounds of ground limestone is used on the soil before sowing the seed. Potatoes receive 1,200 to 2,000 pounds of 6–8–6 in the row when planted. Strawberry plants are set early in spring and receive 500 pounds of 6–8–6 in fall and in each succeeding fall they are allowed to stand. Some growers prefer to fertilize strawberries late in winter or early in spring, but too much fertilizer at that season causes the fruit to be soft. Spinach receives 500 to 800 pounds of 3–12–6 or 6–8–6 when planted and is subsequently top-dressed with one or more applications of 500 pounds of 10–5–5 or 200 to 300 pounds of a nitrogen salt. Green truck crops receive 500 pounds of 6–8–6 when planted and one or more side dressings of 500 pounds of 10–5–5 or 200 to 300 pounds of a nitrogen salt.

The greater part of this soil could be cleared, drained, and profitably cultivated if the demand should increase for dairy products or for the crops to which it is adapted. It is a very fertile soil and if properly drained can be made to produce large crops. Strawberries become very weedy on it. The surface soil puddles or runs together, and considerable power is needed to cultivate it. The tilth of the surface soil can be greatly improved by increasing the supply of organic matter by growing and turning under green-manure crops.

Bladen silty clay loam, swamp phase.—This phase resembles Bladen silt loam but is slightly heavier in texture and occurs at low elevations and in many places is covered with water during strong wind tides. The 3-inch surface soil is grayish-brown plastic silty clay loam. In some places the surface layer to a depth of 4 or 6 inches is mucky. The subsurface to a depth of 8 or 12 inches is light-gray plastic clay loam mottled with rust brown and grayish yellow. The subsoil and substratum are light-gray or mottled gray, brownish-yellow, and rust-brown tough plastic clay. This soil is mapped on 3,968 acres. One body occupies a low area connecting West Neck Creek and London Bridge Creek. Another large area is southeast of Dam Neck Corner, and several smaller ones are found along or at the head of the smaller creeks. None of this soil is cultivated, but a few areas are used as hog pasture. Most areas support a swamp type of vegetation that includes cypress, black tupelo, running briers, and reeds, but some areas have a few pine, yellow poplar, sycamore, and red maple trees. Most areas lie so low that it is impractical to provide artificial drainage.

Coastal beach.—This land type represents the continuous strip of grayish-yellow incoherent sand bordering the Atlantic Ocean and Chesapeake Bay. In most places it is less than 100 yards wide, but south of Sand Bridge it extends inland about a mile and includes what is known as the Wash Flats. It is mapped on 2,752 acres. This type is bare of vegetation and includes the areas that are inundated during

mild storms or very high tides. In some places south of Virginia Beach strata of clay outcrop, and in the Wash Flats some organic matter has been incorporated in the material by former vegetation. The relief is flat or gently sloping to the edge of the water. The material is used as building and road sand, but the principal use of this type is for recreational purposes.

Craven fine sandy loam.—In cultivated fields the 6-inch surface soil is light grayish-brown or light grayish-yellow heavy fine sandy loam. The subsurface layer to a depth of 8 or 12 inches is grayish-yellow slightly compact fine sandy loam. To a depth of 20 to 30 inches the subsoil is yellow or brownish-yellow stiff clay loam or clay that breaks into irregular angular aggregates ¼ to ½ inch on a side when moderately moist but is plastic when wet and very hard when dry. The deeper subsoil is mottled grayish-yellow, gray, and rust-brown stiff clay loam or clay, plastic when wet and very hard when dry. The substratum is mottled gray, grayish-yellow, and brownish-red hard silty clay or clay loam. The entire profile is extremely to very strongly acid.

In wooded areas the 2- to 3-inch surface soil is very dark-gray or dark grayish-brown fine sandy loam. In some places the surface layers are thin, and in cultivated fields the grayish-brown fine sandy loam surface soil rests on the stiff clay subsoil. This soil resembles Norfolk fine sandy loam but it has a heavy subsoil and substratum as contrasted with the friable subsoil and substratum of the Norfolk. It also resembles Woodstown fine sandy loam, but the subsoil of the latter soil is not so heavy and stiff, and the substratum is sandy.

This soil is mapped on 1,216 acres, principally in the southern and southwestern parts of the county. Most individual areas are small and are found along drainageways or on slight knolls or ridges surrounded by Lenoir soils, but many areas have been mapped in association with Norfolk fine sandy loam to indicate places where the subsoil is heavy. About 60 percent of the area is cultivated, but many areas form a small part of fields composed principally of other soils. Potatoes, corn, and soybeans are the most important crops where this soil is extensive. Potatoes yield 200 to 225 bushels an acre, corn 35 bushels, and soybeans 1 to 2 tons of hay.

Land used for potatoes receives 1,600 to 2,000 pounds of 6–8–6 an acre in the row at planting. In most instances this is mixed with the soil, and the seed is placed in a second operation, but a few growers use machines that place the fertilizer and plant the seed in one operation. The land for corn and soybeans receives 300 to 400 pounds of 4–8–4 an acre and, if available, stable manure. These crops are not fertilized when planted between potato rows.

Craven silt loam.—In cultivated fields the 6-inch surface soil of friable silt loam or very fine sandy loam is grayish yellow to light grayish brown and when dry is grayish yellow. The subsurface layer to a depth of 10 or 15 inches is light grayish-yellow slightly compact silt loam. In some places it is very faintly mottled with gray and brownish yellow. This layer breaks into thin horizontal plates when handled carefully. The subsoil to a depth of 20 or 30 inches is yellow to brownish-yellow stiff clay loam or clay, plastic when wet. This material breaks readily into moderately firm irregular angular aggregates ¼ to ½ inch on a side. The deeper subsoil is mottled grayish-yellow, gray,

and rust-brown moderately stiff clay loam or clay to a depth of 36 to 40 inches and is soft and plastic when wet. The substratum is mottled gray, grayish-yellow, and rust-brown stiff clay loam, sandy clay loam, or interbedded fine sand, silt, and clay. The entire profile is extremely to very strongly acid.

In wooded areas the surface layer has a moderately high content of organic matter and is dark gray or dark grayish brown to a depth of 2 or 3 inches. In some places this layer is thin and the subsoil occurs at a depth of 6 to 8 inches. In cultivated fields, only the light grayish-brown surface layer is present. North of Oceana and Lynnhaven the subsoil is olive-yellow clay, and loose sand is found at a depth of 5 feet or more.

Developed from fine-grained marine deposits in well-drained situations, this soil is mapped on 5,952 acres in the northeastern and central parts of the county. It is most extensive in the vicinity of Virginia Beach and north of Oceana and Lynnhaven. It is associated with Lenoir and Bladen soils bordering inlets and drainageways and on slight knolls. Many large individual areas have developed where the necks or peninsulas are narrow. In most places it is about 15 feet above sea level. The relief is nearly flat to flat, but the banks bordering Linkhorn Bay and other parts of Lynnhaven Bay are precipitous or overhanging.

About 50 percent of this soil is cultivated. The most common use is for potatoes, green truck crops, strawberries, and corn. In the vicinity of Virginia Beach and north of Lynnhaven, large areas are forested with loblolly pine, oak, hickory, and black tupelo. Potatoes yield about 200 bushels an acre, spinach 250 to 450 baskets, kale and collards 600 to 800 bushels, strawberries 2,000 to 3,000 quarts, and corn 35 bushels.

Only a small part of the cultivated area is used for winter crops, as there are long periods when the soil is too wet to be worked. The land for potatoes receives 1,500 to 2,000 pounds of 6–8–6 an acre in the row at planting time. Most farmers mix the fertilizer with the soil before planting but a few use machines that place the fertilizer and plant the seed at the same operation. Certified seed grown in Maine, Prince Edward Island, Minnesota, or North Dakota is commonly used. After the lime requirement for spinach has been satisfied with 1,000 to 2,000 pounds of ground dolomitic limestone, the spinach crop receives 500 to 800 pounds of 3–12–6 or 6–8–6 an acre at planting time and is subsequently top-dressed with one or more applications of 500 pounds of 10–5–5 or 200 to 300 pounds of nitrogen salt. If it is planted following a fertilized crop or the soil test for phosphoric acid and potash are high, no fertilizer is supplied until after the crop is thinned. Kale and collards receive 500 pounds of 6–8–6 when planted and are subsequently side-dressed with one or more applications of 500 pounds of 10–5–5 or 200 to 300 pounds of nitrogen salt. Strawberries are set in March and are not fertilized until fall or late in winter, when they receive 500 pounds of 6–8–6, and if they are left over the second season a similar application is made the succeeding fall. Corn is not fertilized on truck farms, but when it is grown in a rotation of corn and soybeans about 400 pounds of 4–8–4 or 4–12–4 is applied. Stable manure is used when available.

Dragston fine sandy loam.—The 7- to 10-inch surface soil is gray to grayish-brown firm heavy fine sandy loam, gray when dry. The

subsurface to a depth of 12 or 15 inches is grayish-yellow or faintly mottled grayish-yellow and gray fine sandy loam that is soft and sticky when wet and slightly compact when dry. The subsoil to a depth of 20 to 24 inches is grayish-yellow to olive-yellow fairly friable clay loam that when wet is soft and sticky. In many places this layer is mottled grayish yellow, brownish yellow, and gray, but everywhere it is predominantly yellow. The lower subsoil to a depth of 30 to 40 inches is highly mottled gray, grayish-yellow, and grayish-brown sandy clay. The substratum is gray or mottled gray, grayish-yellow, and rust-brown sticky sand or fine sand. The entire profile is extremely to very strongly acid. In some places the surface soil is a dark-gray fine sandy loam 10 to 12 inches thick and the subsoil is a moderately plastic clay loam that includes layers or lenses of plastic clay. Though sometimes confused with Lenoir soils, it can be distinguished by the sandy substratum. It also resembles Moyock fine sandy loam, but the subsoil is heavier and the substratum sandier.

Developed from coarse marine deposits on flat or nearly flat imperfectly drained areas, this soil occupies 2,048 acres in the northwestern part of the county in association with Sassafras and Woodstown soils. A few small areas occupy slight depressions in Sassafras or in Woodstown soils, but the greater part and the larger areas occupy the transition from Woodstown or Sassafras to Fallsington and in many places they separate areas of Fallsington from one of these better drained soils.

This type is used extensively for spinach, kale, collards, and snap beans and to a lesser extent for corn and soybeans. About one-half to two-thirds of the area is cultivated, but it is not so intensely farmed as the better drained soils with which it is associated. It is difficult to cultivate during winter, but if open drainage ditches are maintained tillage is possible during all except very wet periods. Spinach yields 300 to 400 bushels an acre, kale 500 to 800 bushels, collards 500 to 800 bushels, snap beans 125 to 175 bushels, corn about 35 bushels, and soybeans 1½ to 2 tons of hay.

The land used for spinach receives 500 to 800 pounds an acre of 3–12–6 or 6–8–6 when planted and is top-dressed one or more times with 500 pounds of 10–5–5 or 200 to 300 pounds of a nitrogen salt during the growth of the crop. If it is planted immediately following a heavy fertilized crop no fertilizer is added until after thinning. Snap beans are fertilized the same as spinach when planted, but they receive only one side dressing of nitrate of soda. Soils used for kale and collards receive 500 pounds an acre of 6–8–6 when planted and are subsequently side-dressed one or more times with 500 pounds of 10–5–5 or 200 to 300 pounds of a nitrogen salt.

Dragston sandy loam.—The 7- to 10-inch surface soil is gray or grayish-brown moderately firm sandy loam, gray when dry. To a depth of 12 to 15 inches the subsurface is grayish-yellow or faintly mottled grayish-yellow and gray sandy loam that when wet is soft and sticky. The subsoil to a depth of 20 or 24 inches is grayish-yellow to olive-yellow fairly friable sandy clay loam or clay loam that is soft and sticky when wet. In many places this layer is mottled grayish yellow, brownish yellow, and gray, but everywhere it is predominantly yellow. The lower subsoil, to a depth of 30 or 40 inches, is highly mottled gray, grayish-yellow, and grayish-brown sandy clay.

The substratum is gray or mottled gray, grayish-yellow, and rust-brown sticky sand or sand containing some small gravel. The entire profile is very strongly to extremely acid. In some places there are many small pebbles on the surface and throughout the soil and subsoil. In a few places the surface is dark-gray sandy loam to a depth of 10 to 12 inches. The subsoil in a few places contains lenses of plastic clay or clay loam and in some others it is clayey sand.

Developed from coarse-grained marine deposits under imperfect drainage on flat or nearly flat relief, this soil occupies 512 acres in the northwestern part of the county, associated with Sassafras and Woodstown sandy loams. Although a few small areas occur in depressions in Sassafras or Woodstown soils, the greater part and the larger areas occupy the transition from Woodstown or Sassafras to Fallsington soils and in many places they separate areas of Fallsington soils from areas of one of the better drained soils. A few small areas occupy low knolls in areas of Fallsington soil and in some of these places the subsoil is sticky or gravelly sandy loam. This soil is utilized and managed in the same manner as Dragston fine sandy loam, and approximately the same or slightly lower yields are obtained.

Dragston silt loam.—In cultivated fields the 6-inch surface soil is gray or grayish-brown firm silt loam or loam. The subsurface layer to a depth of 8 or 10 inches is grayish-yellow or faintly mottled grayish-yellow and gray slightly compact silt loam, soft when wet. The subsoil to a depth of 15 or 20 inches is light-yellow, grayish-yellow, or mottled grayish-yellow, brownish-yellow, and gray slightly plastic clay loam. To a depth of 30 to 40 inches the lower subsoil is mottled grayish-yellow, gray, and rust-brown moderately stiff clay loam. The substratum is gray or mottled gray, grayish-yellow, and rust-brown sticky or clayey sand. The entire profile is extremely to very strongly acid.

In wooded areas the surface soil to a depth of 2 or 3 inches is very dark gray and has a high content of organic matter, and in some places it is dark grayish brown to a depth of 12 to 14 inches. In the vicinity of Kempsville some areas have an olive-yellow plastic clay or clay loam subsoil. These areas might be confused with silt loams of either the Craven or the Lenoir series, but are distinguished by the fact that the substratum below 40 to 44 inches is sticky sand.

In most places this type is associated with areas of Woodstown and Elkton silt loams and in many places it separates areas of these soils. A few small areas have developed in slight depressions in Sassafras, Woodstown, and other soils, two of which are southwest of Pungo and a few in the vicinity of Oceana. These areas have a dark surface soil to a depth of 10 to 14 inches, and in most of them the subsoil is grayish-yellow friable silty clay loam. A total of 1,344 acres is mapped principally in the vicinity of Glen Rock and elsewhere in the northwestern part of the county on nearly flat or flat relief.

Developed under imperfect drainage from a thin layer of comparatively fine-grained marine sediments deposited on sandy material, most areas are separated from natural drainageways by areas of Woodstown or other well-drained soils, but some are situated near the head of small drainageways and have fair surface drainage. The areas that have moderately good surface drainage can be tilled in winter, but open ditches are used to provide adequate drainage on all cultivated areas. Many areas support a dense growth of loblolly pine, black tupelo, yellow

poplar, beech, and red oak and white oak. About one-third of the area is cultivated and of this, about 75 percent is used for spinach, kale, collards, and snap beans; the rest is planted to corn and soybeans. Spinach yields about 300 to 400 bushels an acre, kale and collards 400 to 600 bushels, snap beans 75 to 150 bushels, corn about 35 bushels, and soybeans 1½ to 2 tons.

The land used for spinach receives 500 to 800 pounds an acre of 3–12–6 or 6–8–6 when planted and is subsequently top-dressed one or more times with 500 pounds of 10–5–5 or 200 to 300 pounds of a nitrogen salt. If planted following a heavily fertilized crop, it is not fertilized until after the crop is thinned, and then the usual top dressings are made. Land used for kale and collards receives about 500 pounds of 6–8–6 when planted and is side-dressed one or more times during the growth of the crop with 500 pounds of 10–5–5 or 200 to 300 pounds of a nitrogen salt. Land in snap beans receives about 500 pounds of 5–10–5 or 3–12–6 when planted and is side-dressed with 200 to 300 pounds of nitrate of soda. Some truck growers plant cowpeas, soybeans, or millet as a soil-improving crop during the summer, and a few raise corn or soybeans for feed. These crops are not fertilized. Most of the corn and soybeans are planted as an independent crop, and the land receives 300 or 400 pounds of 4–12–4 or 4–8–8, with stable manure, or heavy applications of stable manure alone. Many farmers grow oats or crimson clover in winter as a soil-improving crop or for pasture or feed.

Dune sand.—Areas of dune sand include bare or nearly bare grayish-yellow sand that is subject to wind action. The sand forms a more or less continuous strip, varying in width from a few hundred feet to about half a mile, from the Virginia-North Carolina line to the Norfolk County line on Chesapeake Bay. It is mapped on 2,560 acres. In most places the relief is hilly to choppy, and short steep slopes are common. The average elevation is about 35 feet, but it ranges from a few feet to about 100 feet above sea level, and in some places both extremes are found within a few hundred feet. A sparse vegetation, consisting of a coarse bunchgrass, live oak, and myrtle, tends to anchor small areas included in this classification, but more than 50 percent of it is bare.

Dune sand, stabilized phase.—This classification is used to describe areas where vegetation has become established on former sand dunes and has stopped the movement of the sand by wind. On most areas this encroachment of vegetation was natural and took place many years ago, but recently some has been established between man-made sand fences erected on a few areas. In areas that have become stabilized recently the sand is grayish yellow throughout, but where stabilization took place many years ago, as on some parts of Cape Henry, a feeble Podzol profile has developed. This profile is distinguished by 3 or 4 inches of organic matter overlying a white sand surface soil extending to a depth of 2 or 3 inches. The subsoil is slightly cemented coffee-colored loamy sand that grades, at about 6 inches, into brown loose loamy sand that extends to a depth of 15 to 20 inches. The substratum is grayish-yellow loose incoherent sand. In most places the first inch of the surface soil is dark-gray sand, the

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second inch is gray loose loamy sand, the subsoil, to a depth of 6 to 7 inches, is brown loamy sand, and the substratum is grayish-yellow sand. The relief is gently rolling to rolling, but local variations are not so great as in typical dune sand. This land class is found associated with typical dune sand and is mapped on 5,568 acres. The vegetation consists of thickly branched stunted loblolly pine and dwarf live oak, myrtle, and coarse bunchgrass. In some places it furnishes scant grazing, and the areas in the southern part of the county were once ranged by wild ponies.

Included with this classification are a few flat areas in the vicinity of Virginia Beach that support a growth of coarse grass. The upper part of the profile is similar to the one described immediately above, but below a depth of 20 inches the substratum is mottled gray, grayish yellow, and rust brown. In many places, at depths of 1 to 3 feet, stiff silty clay occurs.

Also included are low flat areas in the vicinity of Little Creek, with a profile similar to the inclusion just described, but these support a sparse growth of loblolly pine and broomsedge and do not have a clay substratum.

Elkton silt loam.—In cultivated fields under normal moisture conditions the surface soil to a depth of 6 to 8 inches is gray to dark-gray slightly compact silt loam, becoming nearly white when dry. The subsurface layer to a depth of 10 or 12 inches is light-gray or gray mottled with grayish-yellow and rust-brown soft sticky silt loam. To a depth of 30 to 40 inches the subsoil is light-gray or gray mottled with grayish-yellow and rust-brown plastic clay or clay loam. The substratum is gray or gray mottled with grayish-yellow and rust-brown sticky sandy loam to loose loamy sand. The entire profile is extremely to very strongly acid.

In forested areas the surface layer to a depth of 3 or 4 inches is very dark-gray silt loam, with a high content of organic matter. In some places the surface soil is dark-gray silt loam 12 or 14 inches thick. In a few places the surface soil is silty clay loam, and in some places it is a very fine sandy loam. This is one of the most variable soil types in the county, and lenses of loose loamy sand or very stiff tough plastic clay, varying in thickness from less than 1 inch to more than 1 foot, are found in all layers. All these variations may be found within a radius of 100 yards. In some places the subsoil is light gray and in others it is highly mottled gray, grayish yellow, and rust brown, but everywhere it is predominantly gray. This soil may be confused with Bladen soils in some places, but it is distinguished from them by the fact that it has lenses of sand in the subsoil and the substratum below 30 to 40 inches, whereas in the Bladen soils these layers are tough plastic clay.

The 8,896 acres mapped occurs in all parts of the county and is associated with all soil types. The relief is flat or nearly flat, and many individual areas are large, but some small ones occupy slight depressions in Sassafras, Woodstown, Dragston, or other soils. A few areas are on slight knolls or ridges surrounded by Bladen soils. This soil has developed in poorly drained positions from interbedded fine sand, silt, and clay of marine origin.

About 25 percent of this soil is cultivated, chiefly to corn, soybeans, and potatoes. Some strawberries and green truck crops also are

grown. Corn yields 20 to 25 bushels an acre, soybeans 20 bushels of dry beans or 1½ tons of hay, and potatoes 175 to 200 bushels.

Artificial drainage is provided by the use of open ditches in all cultivated areas. These are satisfactory and easily maintained, as the subsoil has sufficient clay to stand up well over a long period of years. Many fields of corn and soybeans are not fertilized, but in most places 300 or 400 pounds an acre of 4–12–4 or 4–8–8 are applied, or heavy applications of stable manure are made. Where potatoes are grown, the land receives 1,500 to 1,800 pounds of 6–8–6. Many areas now in timber could be cleared and cultivated if the demand for dairy products, potatoes, or green truck crops should increase. This is a fertile soil and its productivity can easily be maintained by adequate drainage and maintenance of organic matter in the surface soil.

Fallsington fine sandy loam.—In cultivated areas the 6- to 8-inch surface soil is gray to dark-gray compact fine sandy loam and in many places this is nearly white when dry. To a depth of 12 or 15 inches the subsurface is light-gray or mottled gray, grayish-yellow, and rust-brown heavy sticky fine sandy loam. To a depth of 30 or 40 inches the subsoil is gray or mottled gray, grayish-yellow, and rust-brown sticky clayey sand, sandy clay loam, or interbedded sand and clay. The substratum is gray soft loamy sand to clayey sand, in some places mottled with rust brown. The entire profile is extremely to very strongly acid.

In forested areas the surface soil to a depth of 2 or 3 inches is very dark-gray fine sandy loam, high in organic matter. In a few places the dark-gray to very dark-gray fine sandy loam surface soil is 12 to 14 inches thick; in some places the surface soil is sandy loam. This soil varies considerably but within comparatively narrow limits. All layers may be gray or highly mottled gray, grayish yellow, and rust brown, but everywhere gray is the predominating color. Lenses of sand or tough plastic clay, varying in thickness from less than 1 inch to more than 1 foot, are often present in the subsoil and in some places the subsoil is a tough plastic clay similar to that of Bladen soils.

Developed under poor drainage from interbedded sand and clay of marine origin, this soil is mapped on 8,320 acres in all parts of the county. Some large areas are on flat or nearly flat relief, but many small areas occupy slight depressions in well-drained or imperfectly drained soils.

About 40 percent of this soil type is cultivated, the principal crops being corn, soybeans, potatoes, strawberries, and green truck. Corn yields 20 to 25 bushels an acre, soybeans 20 bushels of dry beans or 1½ tons of hay, potatoes 175 to 200 bushels, strawberries 2,000 to 3,000 quarts, spinach 250 to 350 bushels, and kale and collards 400 to 600 bushels.

Artificial drainage must be provided before this soil can be cultivated, and open ditches are satisfactorily used for this purpose. Corn and soybeans are grown on some farms without fertilization or with applications of stable manure only. On other farms they are planted between potato rows at the last cultivation or after the potatoes are harvested, and receive no additional fertilization, but on most farms where they are grown as an independent crop the land receives 200 pounds an acre of 4–12–4 or 4–8–4. Potatoes receive 1,500 to 2,000

pounds of 6–8–6 in the row when planted. Strawberry plants are set in spring and are not fertilized until fall or late winter, when they receive 500 pounds of 6–8–6. This fertilization is repeated each fall the berries are allowed to stand. Spinach receives 500 to 1,000 pounds of 3–12–6 or 6–8–6 when planted and is top-dressed one or more times with 500 pounds of 10–5–5 or 200 to 300 pounds of a nitrogen salt. Kale and collards receive 500 pounds of 6–8–6 when planted and are side-dressed one or more times with 500 pounds of 10–5–5 or 200 to 300 pounds of a nitrogen salt. This soil is potentially good and is fairly productive if drainage is adequate and the content of organic matter is maintained.

Hyde silty clay loam.—The surface soil is very dark-brown to black mucky silty clay loam, which at 10 to 15 inches grades into very dark-gray or bluish-gray tough plastic clay or sticky clay. In some places 3 or 4 inches of peat or muck are on the surface. The surface soil in a few places is loam or fine sandy loam and the subsoil soft loam or sandy clay. Beneath a depth of 24 to 30 inches the subsoil is gray or mottled gray, grayish-yellow, and rust-brown tough plastic clay or extremely heavy sticky sandy clay. The entire profile is extremely to very strongly acid.

The largest area is about 1 mile north of Creeds, and other areas of about 100 acres each are 2½ miles south of Oceana and 3 miles south of Rosemont. A few smaller areas are found at various points in the central and southern parts of the county. The total of 704 acres is developed on flat relief in very poorly drained situations, and most areas are covered with water the greater part of the year. Most areas are inaccessible and are surrounded by Bayboro silt loam or some other poorly drained soil.

As this soil is found near the center of large flat areas far removed from natural drainageways, very little of it is cultivated. Long, deep ditches would have to be dug to drain most areas adequately. In most places it is densely forested with black tupelo, loblolly pine, sweetgum, red maple, and willow oak and has an almost impenetrable undergrowth of reeds, briers, honeysuckle, and wild grape. It is inherently a strong soil and, if drained and reclaimed, would produce large yields of corn and soybeans and make good pastures.

Lenoir fine sandy loam.—In cultivated fields the 5- to 7-inch surface soil is gray or grayish-brown firm fine sandy loam. The subsurface to a depth of 8 or 12 inches is grayish-yellow moderately heavy fine sandy loam, in many places mottled with gray and brownish yellow. The subsoil to a depth of 24 or 30 inches is mottled grayish-yellow, brownish-yellow, and gray stiff tough clay or clay loam, plastic when wet and very hard when dry. The substratum is mottled gray, grayish-yellow, and rust-brown stiff clay or interbedded clay, silt, and fine sand. The entire profile is extremely to very strongly acid. No apparent soil structure is developed in any layer, but when dry the subsoil breaks into irregular angular hard lumps 1 inch or more in diameter.

In forested areas the surface soil is dark-gray or dark grayish-brown fine sandy loam with a high content of organic matter at a depth of 2 or 3 inches. In some places the upper 6 or 8 inches of the subsoil is grayish yellow to brownish yellow, and in a few places the subsoil is olive yellow to a depth of 20 to 30 inches.

The 1,600 acres, developed from fine-grained marine deposits under imperfect drainage conditions on nearly flat relief, is well distributed over the eastern, central, and southern parts of the county but is most extensive in the southwestern part. Most individual areas are small but some, especially in the Blackwater district, consist of more than 200 acres. In many places it occupies a position intermediate between the well-drained Craven soils and the poorly drained Bladen and Elkton. On most areas open ditches are necessary to provide drainage, as the heavy subsoil prevents absorption of rainfall, but many areas near the heads of drainageways have fair surface drainage. This soil warms late in spring and is not commonly cropped during winter. The surface becomes hard when dry and runs together when wet, but this can be corrected to some extent by increasing the content of organic matter.

About half of this soil is under cultivation, mainly to potatoes, corn, and soybeans, but with some truck crops and strawberries. Potatoes yield 125 to 200 bushels an acre, corn 20 to 30 bushels of grain or 6 to 8 tons of silage, and soybeans 20 to 25 bushels of dry beans or 1¼ to 1¾ tons of hay.

Land used for potatoes receives an application of 1,600 to 2,000 pounds an acre of 6–8–6. Most growers mix the fertilizer with the soil in the row before dropping the seed, but a few use machines that place the fertilizer and plant the seed at one operation. Corn and soybeans are frequently planted between the potato rows at the last cultivation and receive no additional fertilizer, but when potatoes are planted as an independent crop the land receives 300 to 400 pounds of 4–12–4 or heavy applications of stable manure.

Lenoir silt loam.—In cultivated fields the surface soil to a depth of 5 or 6 inches is gray or grayish-yellow slightly compact silt loam to very fine sandy loam. The subsurface to a depth of 8 or 12 inches is mottled grayish-yellow, gray, and yellowish-brown slightly compact silt loam. The subsoil to a depth of 18 or 24 inches is mottled grayish-yellow, yellow, and gray stiff tough clay, and the substratum is highly mottled gray and grayish-yellow stiff clay with some spots or streaks of rust brown or brownish red. The entire profile is extremely to very strongly acid.

In forested areas the 2- or 3-inch surface soil is dark-gray silt loam or very fine sandy loam. In many places the subsurface layer and the upper 6 or 8 inches of the subsoil is light yellow or grayish yellow. In the vicinity of Oceana, Londonbridge, and Lynnhaven, the subsoil to a depth of 20 or 24 inches is an olive or greenish-yellow very stiff plastic clay. In some places there are thin layers or lenses of silt and very fine sand in the subsoil and substratum, and north of Londonbridge and Lynnhaven the substratum below 5 feet is loose gray or grayish-yellow sand. In many places north of Lynnhaven the silty surface layer extends to a depth of 15 to 20 inches before the stiff olive-colored clay is reached.

A total area of 8,384 acres is mapped, most of it in the north-central part of the county. It is associated with the Bladen and Craven soils, and in many places it occurs between the two. Extensively developed where shallow drainageways cut into the large areas of Bladen soils, this soil occurs on nearly flat or flat relief, but there is some very gently sloping land. Derived from very fine marine deposits, this

soil is imperfectly drained, although in some places surface drainage is good.

About 40 percent of the area is cultivated. Corn and soybeans are the principal crops, but strawberries and green truck are successfully grown on some areas. Corn yields 20 to 30 bushels an acre of grain or 6 to 8 tons of silage, soybeans 1 to 1½ tons of hay, spinach 300 to 325 baskets, kale and collards 600 to 800 bushels, and strawberries 2,000 to 3,000 quarts.

Except for heavy applications of stable manure, much of the land used for corn and soybeans is not fertilized, but many areas receive 300 to 400 pounds of 4–12–4 an acre. Strawberries occupy the land for 2 or 3 years, and the land receives 500 pounds of 6–8–6 each fall or late in winter. Quackgrass and other grasses are a serious pest in strawberries. Spinach and other green truck crops are grown only on areas near natural drainageways where surface drainage is good. The soils are fertilized for spinach in the same manner as on Craven silt loam, that is, 500 to 800 pounds an acre of 3–12–6 or 6–8–6 when planted and one or more top dressings of 500 pounds of 10–5–5 or 200 to 300 pounds of nitrogen salt. In very wet years spinach may not thrive on this soil, but in dry years the yield may exceed that of the better drained soils. Soils used for kale and collards receive 500 pounds of 6–8–6 when planted and are subsequently side-dressed one or more times with 500 pounds of 10–5–5 fertilizer or 200 to 300 pounds of nitrogen salt.

Made land.—This classification of 192 acres is used to describe areas that have been built or filled in by sand dredged from nearby waterways. One area at Little Creek is used as a railroad yard and ferry dock. On other areas along the North Landing River the refuse was dumped when the Chesapeake and Albemarle Canal was dredged.

Marsh.—The material of marsh is similar to that of tidal marsh, but it is inundated by fresh or very slightly brackish water. Tidal inundations are not the regular ebb and flow of ocean tide, but are caused by winds and periods of inundation that may last several days. Vegetation consists of cattails, celery grass, and reeds. In some places there is 3 or 4 to 12 inches of sedge peat on the surface. Marsh is mapped on 17,536 acres, or 10.2 percent of the total area of the county. This land class borders Back Bay and the North Landing River, and one small area is near Little Creek. On areas in Back Bay that are frequented by migratory wild fowl, hunting is an important source of revenue to local residents.

Moyock fine sandy loam.—In cultivated fields the 6- to 8-inch surface soil is gray to dark-gray or grayish-brown loose to firm fine sandy loam that when dry is medium gray. The subsurface layer to a depth of 10 or 12 inches is grayish-yellow or mottled grayish-yellow, gray, and brownish-yellow slightly compact fine sandy loam. To a depth of 20 or 30 inches the subsoil is mottled grayish-yellow, gray, and rust-brown or brownish-yellow moderately firm but friable fine sandy clay loam or loam that feels much like moist corn meal. The substratum is highly mottled gray, grayish-yellow, and rust-brown friable but somewhat sticky sandy clay or compact but friable clayey sand. The entire profile is extremely to very strongly acid. There is no apparent structure developed in any part of this soil, but in many places the subsoil

breaks into small moderately hard rounded to subangular aggregates. These give it a granular structure and can be crushed between the fingers with moderate pressure. The surface and subsoil are poorly aerated, and water percolation is very slow.

In some wooded areas the upper 2 or 3 inches of the surface soil has a high content of organic matter and is very dark gray. The subsurface layer and the upper 4 to 10 inches of the subsoil in some places are unmottled grayish yellow or olive yellow. In some places there are lenses of stiff clay in the subsoil and substratum. This soil resembles the Dragston but is distinguished by the heavier mealy consistence of the subsoil and the characteristic heavier substratum.

The 7,040 acres mapped is widely distributed over the eastern and southern parts of the county. It is associated with the Norfolk and Elkton soils, in many places separating areas of these soils. Many areas occupy slight elevations in the Elkton and others occur in slight depressions in the Norfolk. Developed from comparatively fine-grained marine deposits on nearly flat relief, the surface drainage is fair to poor, and internal drainage is slow. In most places open ditches are necessary to provide adequate drainage.

About half the area is cultivated. Potatoes, corn, and soybeans are the principal crops, but some of the smaller areas closely associated with Norfolk fine sandy loam are used for winter spinach and strawberries. Potatoes yield 175 to 225 bushels an acre, corn 30 to 35 bushels, soybeans 1½ tons of hay, spinach 300 to 450 baskets, and strawberries 2,000 to 3,000 quarts.

Land used for potatoes receives 1,600 to 2,000 pounds an acre of 6–8–6 in the row when planted. Corn and soybeans are commonly planted between the potato rows at the last cultivation or after the potatoes are harvested and receive no additional fertilizer. When planted as an independent crop the land receives 300 to 400 pounds of 4–12–4 or heavy applications of stable manure. For spinach 500 to 1,000 pounds of 3–12–6 or 6–8–6 are applied to land used and one or more top dressings of 500 pounds of 10–5–5 or 200 to 300 pounds of nitrogen salt are made during the growth of the crop. Strawberries are set in early spring, and the land is fertilized in fall or late in winter with 500 pounds of 6–8–6. This fertilization is repeated each fall until the berries are plowed under, usually after the second crop is picked.

Included with this soil are several scattered areas that are darker colored in the surface and contain more organic matter than the typical. In a larger acreage these would have been separated as a separate soil type. The subsoil is dominantly gray or grayish yellow, and the texture and consistence are essentially the same as in the typical. Locally the surface soil is a sandy loam, particularly in about 50 acres on Knotts Island. In a few places the texture is a silt loam. Potatoes, corn, and soybeans are the principal crops grown, although a small acreage is used for strawberries.

Norfolk fine sandy loam.—In cultivated fields the surface soil to a depth of 6 to 8 inches is loose light grayish-brown fine sandy loam or loamy fine sand having a slight content of organic matter. The subsurface layer to a depth of 10 or 14 inches is grayish-yellow friable fine sandy loam. The subsoil is grayish-yellow to brownish-yellow fine sandy clay loam or clay loam to a depth of 22 or 28 inches. The ma-

terial in this layer is friable under average moisture conditions but becomes slightly sticky when wet. It has very little structure, but it is possible to separate the mass into small irregular angular fragments about an eighth of an inch on a side. The lower subsoil layer to a depth of 30 or 40 inches is slightly compact faintly mottled grayish-yellow, gray, and brownish-yellow fine sandy clay loam. The substratum is moderately compact mottled gray, grayish-yellow, and rust- or reddish-brown fine sandy loam to clayey sand and in a few places is sticky clay loam and is extremely acid throughout.

In forested areas the surface soil is dark-gray or dark grayish-brown fine sandy loam or loamy fine sand to a depth of 2 or 3 inches. In a few places the subsoil of slightly sticky clay loam has a tendency to "roll" on the soil auger.

A total of 5,376 acres is mapped and is most common on Pungo Ridge south of Oceana. Most individual areas are small. Developed in well-drained positions from sandy clay marine deposits, this soil is not so well drained as the Sassafras because the relief is more nearly flat and the depth to the water table is about 3 feet much of each year. The very slight depressions are occupied by Moyock fine sandy loam.

The most general use of this soil is a two-crop, 1-year rotation of potatoes and corn, but some of it is used for sweetpotatoes, strawberries, spinach, and other truck crops. Potatoes and sweetpotatoes yield 150 to 225 bushels an acre, corn 35 bushels, strawberries 2,500 to 3,000 quarts, spinach 300 to 350 bushels, snap beans 100 to 200 bushels, and garden peas 100 to 150 bushels.

Potatoes (pl. 3, *A*) are planted in February and receive 1,600 to 2,000 pounds an acre of 6–8–6 at planting time. Certified seed from Maine, Prince Edward Island, Minnesota, or North Dakota is commonly used at the rate of 9 to 12 bushels an acre. Corn or soybeans may be planted between the rows of potatoes early in June, and the potatoes are dug late in June. Strawberries, spinach, snap beans, garden peas, and other vegetables receive the same treatment as on Sassafras fine sandy loam.

As developed in this region the surface soil and the subsoil of this type are browner than in normal Norfolk soils. Included are a few areas, the largest about 1½ miles south of Oceana, where the surface soil is sandy loam to coarse sandy loam and the subsoil a sticky sandy loam.

Norfolk loamy fine sand.—The 6- to 8-inch surface soil is loose grayish-brown loamy fine sand or fine sand, and the subsurface layer to a depth of 20 or 25 inches is loose to very friable grayish-yellow loamy fine sand. At a depth of 36 to 40 inches the subsoil is friable grayish-yellow fine sandy loam or sandy loam, and the substratum is a slightly compact gray sand mottled with grayish brown and grayish yellow.

This soil type is mapped on 384 acres, most of it in the southern part of the county. A large area is just southwest of Back Bay, on the road to Creeds. Most individual areas are small and represent low knolls in areas of Norfolk fine sandy loam or sandy ridges in areas of imperfectly or poorly drained soils. When cultivated this type forms part of a field located principally on another soil type and in many places is considered an undesirable part of the field, as crops wilt during dry periods and wind erosion in spring is serious if the surface remains uncovered. Yields are much less than on Norfolk fine sandy loam.

A, Potatoes growing on Norfolk fine sandy loam. Photographed early in June, at the time of blossoming. *B*, Spinach being harvested in far background of a 100-acre field. Trucks haul the crop to the packing house. Sassafras fine sandy loam in foreground; Dragston and Woodstown fine sandy loams in background.

Truck crops growing on Woodstown fine sandy loam: *A*, Collards ready to harvest in November. *B*, Cabbage ready to harvest in May.

Included with this soil type are areas where the surface soil is loamy sand or loamy coarse sand. In some places there is little or no subsoil development, but white sand is found at 24 to 30 inches below the surface, and in a few places a rather stiff fine sandy clay is found at 30 to 35 inches. On Knotts Island the subsoil below 30 inches is reddish-brown fine sandy clay loam and the substratum grayish-yellow loamy fine sand.

Pits.—In pits made to obtain clay for brick making and sand for construction purposes, clay, underlying Craven, Lenoir, and Bladen silt loams, was excavated in the vicinity of Lynnhaven and Oceana, and sand was excavated from dune sand in the vicinity of Cape Henry. These areas are not suitable for agriculture.

Portsmouth loam.—The surface soil to a depth of 10 to 15 inches is very dark-gray to black mellow loam or fine sandy loam, high in organic matter. The subsoil is gray or mottled gray and grayish-yellow friable fine sandy clay or fine sandy loam. The substratum is mottled gray and grayish-yellow friable fine sandy clay with some rust-brown streaks. The entire profile is extremely to very strongly acid. In some places the dark-colored surface soil extends to a depth of 20 inches and in a few places there is a dark-brown indurated layer 2 or 3 inches thick immediately beneath the dark-colored surface. In some places a large quantity of sand is in the subsoil and substratum, and in a few places these layers are gray or very faintly mottled with grayish yellow and rust brown.

This soil is mapped on 2,752 acres in large individual areas in the southern part of the county and in a few small ones in the east-central part. The relief is flat, and most areas are at an elevation of less than 15 feet. The soil has developed in very poorly drained places from mixed marine deposits.

This is a good soil, but most areas are very difficult to drain. When properly drained, it is productive and the mellow surface soil is easily cultivated. Artificial drainage is provided by means of open ditches for about 20 percent of the area in order to bring it into cultivation. Corn, soybeans, and potatoes are the principal crops grown. Corn yields about 35 bushels an acre, soybeans 25 bushels of dry beans or 2 tons of hay, and potatoes 150 to 250 bushels.

Corn and soybeans are grown on some farms without fertilization or with the addition of stable manure, but higher yields are obtained when the addition of 300 pounds of 4–12–4 or 4–8–8 is applied. For potatoes an application of 1,500 to 2,000 pounds of 6–8–6 is made. On many farms corn or soybeans are planted without additional fertilization between the potato rows at the last cultivation early in June.

Sassafras fine sandy loam.—The surface soil is grayish-brown or light-brown loose to mellow fine sandy loam to a depth of 6 or 8 inches, and the subsurface soil to a depth of 12 or 15 inches is grayish-yellow mellow but friable fine sandy loam. Both layers are extremely acid and are easily penetrated by roots. Practically all the organic matter in the entire profile is concentrated in the surface soil, but even here the content of plant nutrients is low. The subsoil to a depth of 26 or 38 inches is reddish-brown or yellowish-brown friable clay loam or sandy clay, and in most places the lower 6 to 10 inches contains more sand and fine sand than the upper part. The structure consists of fine granules,

the mass breaking easily into soft irregular angular aggregates about an eighth of an inch or less on a side. The soil is very friable when moderately moist but becomes slightly sticky when wet. This material is very strongly acid. The extremely acid substratum is yellowish-brown slightly sticky loamy fine sand to loamy sand. In most places the soil is on nearly flat to very gently undulating relief at elevations of 15 to 25 feet. It has developed in well-drained situations from sandy marine deposits.

The most common variation occurring in this type is in the color and depth of the surface layer. In some places the light-brown surface soil extends to a depth of 12 to 15 inches and may rest directly on the clay loam subsoil; in some wooded areas it is only 3 or 4 inches thick; and in a few places it is dark brown to very dark brown to a depth of 8 to 10 inches. This latter variation is most common near the shore and may be caused by oystershells dumped or washed there, as in many places fragments of shells are found incorporated in the surface soil. The texture of the subsoil varies slightly and in some places is clayey fine sand and in a few places loam. In some areas where associated with Craven soils, the subsoil is stiff plastic clay loam or clay. The thickness of the subsoil varies locally. In a few places it is found at a depth of 22 inches, in others at 40 to 44 inches.

This soil is most common bordering the inlets of Lynnhaven Bay and Little Creek in the northern part of the county and on Pungo Ridge, which extends through the east-central part. A total of 8,960 acres is mapped.

About 90 percent of this type is under cultivation. It is well adapted to all the crops grown, but in northern parts most areas are used for green truck crops, sweetpotatoes, and strawberries. On the southern part of Pungo Ridge, potatoes, sweetpotatoes, garden peas, and snap beans are extensively grown. Two or three crops are grown in many areas—fall and winter spinach followed by snap beans; fall kale, collards, or cabbage followed by snap beans; or fall snap beans followed by winter cabbage and spring snap beans—in addition to a green-manure crop, corn, or soybeans. The yield of spinach (pl. 3, *B*) varies from 300 to 600 bushels an acre for each crop, depending largely on the state of maturity when harvested. The spring crop of snap beans yields 100 to 200 bushels and the fall crop 50 to 100 bushels. Kale and collards yield 600 to 900 bushels, cabbage 6 to 8 tons, strawberries 2,500 to 3,000 quarts, potatoes and sweetpotatoes 150 to 250 bushels, garden peas 100 to 150 bushels, corn 30 to 35 bushels, and soybeans 20 to 25 bushels of dry beans or 1½ to 2 tons of hay.

Care must be taken to maintain the organic content to insure good crop growth, and commonly one or more green-manure crops are grown during the year. Alfalfa can be successfully grown when the acidity has been corrected. This is one of the most adaptable soils in eastern United States, as practically any crop suited to this latitude can be grown on it.

Included with this type are soils of too small extent to be shown on a map of the scale used and soils that occupy a small total area. The most common of the former are Woodstown and Dragston soils, in the small depressions common on a few of the areas, particularly in the vicinity of Oceana. At the southern edge of Virginia Beach a small part of the area mapped as fine sandy loam has a coarse sandy

loam surface, and at the entrance of Little Creek Ferry, and elsewhere in the same vicinity, the surface texture is very fine sandy loam and the subsoil a rather plastic clay or clay loam. Some inclusions are small areas of Sassafras loamy fine sand, in most places on low ridges. In a few places adjacent to natural drainageways the surface layer has been worn away and the grayish-yellow subsurface is exposed. The steep or even precipitous banks commonly found along Broad Bay and other parts of Lynnhaven Bay are of too small extent to be mapped as separate units.

The land used for growing spinach receives 1,600 to 2,000 pounds an acre of fertilizer, of which 500 to 1,000 pounds of 3–12–6 or 6–8–6 are applied at planting and the rest in one or more top dressings or side dressings of 500 pounds of 10–5–5 or 200 pounds of nitrogen salt during the growing period. The number of top dressings depends on the growth of the crop, the quantity of rainfall, the season, and the prevalence of disease. If spinach follows a fertilized crop or if the soil test is high for available phosphoric acid and potash, no fertilizer is applied until after thinning and then two or more top dressings are made during the growth of the crop. If the reaction is acid, lime is applied before planting.

Kale, collards, and cabbage require a fertilizer that has a high content of nitrogen. It is a common practice to apply 500 to 1,000 pounds of 6–8–6 an acre at the time of planting and then to top-dress with 500 pounds of 10–5–5 or 200 to 300 pounds of nitrogen salt. Following a fertilized crop these crops receive only top dressings. This practice helps to control weeds because if heavy applications of nitrogen fertilizers are made at the time of planting, weeds may take it from the soil and may also choke the crop.

Sweetpotatoes receive 500 to 1,000 pounds of 3–3–15 an acre. Strawberries are planted in March or early April, usually following kale or spinach, and they bear a crop in May of the next year. They are not fertilized until fall or late winter, when they receive 600 to 1,000 pounds of 6–8–6, and are usually plowed up after the second crop is picked. Potatoes receive 1,600 to 2,000 pounds of 6–8–6, which is mixed with the soil on most farms before the potatoes are planted, but some growers use machines that place the fertilizer and plant the seed in one operation. Snap beans and garden peas receive 800 to 1,000 pounds of 5–10–5 or 3–12–6 at planting and are side-dressed with 200 pounds of nitrate of soda during the early flowering period. Corn, soybeans, and green-manure crops are planted following heavily fertilized crops and do not ordinarily receive additional fertilization. In some instances corn or soybeans are planted between potato rows at the last cultivation.

Sassafras sandy loam.—The 6- to 8-inch surface soil is grayish-brown to light-brown loose very acid sandy loam or loamy sand that in many places includes some coarse sand and small gravel. The subsurface soil to a depth of 12 or 15 inches is grayish-yellow or yellow moderately friable very acid sandy loam. To a depth of 24 or 34 inches the subsoil is reddish-brown or yellowish-brown friable very strongly acid sandy clay or clayey sand. The substratum is slightly sticky very acid reddish- or yellowish-brown sand, coarse sand, and small gravel. Practically all the organic matter is in the surface soil, but the content is low.

In a few places the surface soil is dark-brown sandy loam to a depth of 12 or 14 inches, and the grayish-yellow subsurface soil may be only 1 or 2 inches thick or entirely absent. In some wooded areas the brown surface soil is only 3 or 4 inches thick. Included with this type are a few areas where the surface soil is loamy sand and the subsoil a sandy loam.

Developed from unconsolidated highly siliceous marine deposits, this soil is mapped on 1,408 acres; most of it is in the northwestern part of the county, but a few small areas are found associated with Sassafras fine sandy loam in other parts. The relief is nearly flat to very gently undulating, and both surface and internal drainage are good.

This soil is adapted to the same crops as Sassafras fine sandy loam and is managed in the same manner. Yields are slightly lower in some places, and care must be exercised to maintain the supply of organic matter.

Sassafras silt loam.—In cultivated fields the surface soil to a depth of 6 inches is grayish-yellow or grayish-brown fairly compact silt loam that breaks into soft thin horizontal plates if handled carefully. This layer is strongly acid. The subsurface layer to a depth of 8 or 10 inches is grayish-yellow firm silt loam that breaks into soft, thin horizontal plates; it is also strongly acid. In many places this layer is faintly mottled with grayish yellow and yellowish brown. The subsoil to a depth of 28 or 36 inches is reddish- or yellowish-brown rather stiff clay or silty clay loam that breaks into small irregular angular aggregates under average moisture conditions but is brittle when dry and slightly plastic when wet. This layer is strongly acid. In some places the lower part of this subsoil is faintly mottled with grayish yellow. The substratum is mottled gray, grayish-brown, and rust-brown fine sandy clay, silty clay, or interbedded fine sand, silt, and clay. In most places the substratum below 5 feet is loose or slightly compact gray or grayish-yellow fine sand, sand, and small gravel.

This soil is mapped on 1,024 acres, and in most places occupies waterfront positions associated with Craven silt loam. The largest area borders Linkhorn Bay, northwest of Virginia Beach. Here it is associated with Sassafras fine sandy loam, but occurs at a slightly lower elevation. In most places this soil is at an elevation of 10 to 15 feet and occupies a nearly flat surface with steep or precipitous breaks along drainageways and inlets.

This type is not important for agriculture as most areas are small and many are used as home sites or are forested. Most cultivated areas form part of a field located largely on another soil type and these parts are managed according to the requirements of the associated soil. This soil resembles Craven silt loam in crop adaptability and cultural requirements, and in many places the two occur in the same field. It is a good, strong agricultural soil and when fertilized and limed produces good yields of corn, potatoes, soybeans, and hay.

Swamp.—This classification is used for wet timbered areas along drainageways and streams. In some places the soil material is sand, in others clay, and frequently there is a foot or more of peat or a very small quantity of alluvium on the surface. The largest areas of swamp lie along the North Landing River, but some are found in

other sections, and the aggregate area is 11,840 acres, or 6.9 percent of the county. Cypress is an important component of the vegetation. Other trees are black tupelo, sweetgum, and water oak, and everywhere there is a thick, tangled underbrush of briers, wild grape, and myrtle. This land type has been an important source of timber, and in its present condition it is not suitable for any other purpose.

Swamp-dune sand complex.—This complex is used to describe the area on Cape Henry known as "The Desert" and now included in the Seashore State Park. An area of 1,600 acres is mapped. Here many narrow strips, in many places less than 100 feet wide, of dune sand, stabilized phase, are found in large areas of swamp. In many places narrow strips of swamp and dune sand, stabilized phase, alternate, the latter paralleling the beach and possibly representing old beach lines or sand bars. The Podzol profile described under dune sand, stabilized phase, is here best developed. Much of the area of swamp included in this complex has 2 or 3 feet of peat on the surface.

Tidal marsh.—This land type includes areas inundated by salt-water tides. The material is gray to dark-gray silty clay with varying quantities of organic matter in all stages of decomposition, and in a few places it is sandy. It occurs in narrow, more or less continuous, areas bordering all parts of Lynnhaven Bay, Little Creek, and the Eastern Branch Elizabeth River. On some wide areas in shallow inlets the marsh grass extends from shore to shore. The vegetation is a dense growth of coarse grass or reeds and is not utilized for any purpose. The soft oozy material will not support cattle, and consequently tidal marsh is not used for pasture. A total of 5,568 acres is mapped.

Woodstown fine sandy loam.—In cultivated fields the 6- to 8-inch surface soil of friable fine sandy loam is grayish brown when moist and grayish yellow when dry. The subsurface layer to a depth of 12 or 15 inches is grayish-yellow firm fine sandy loam. The subsoil to a depth of 20 or 30 inches is brownish-yellow sandy clay loam or clay loam, normally somewhat friable but rather stiff and slightly plastic when wet. The lower subsoil layer to a depth of 36 or 42 inches is faintly mottled grayish-yellow, brownish-yellow, and gray sticky sandy clay loam to clay loam that becomes more highly mottled, the gray fraction increasing in prominence, toward the lower limit of the layer. The substratum is gray sticky sand, in most places faintly mottled with grayish-yellow and in a few places with rust brown. The entire profile is strongly acid except in fields cultivated to spinach, where lime has been added to correct the reaction. The subsoil layers have a slight tendency to break into soft irregular angular aggregates one-fourth to one-half inch on a side.

In most wooded areas the surface soil is very dark grayish-brown fine sandy loam to a depth of 3 or 4 inches; in some places it is 10 or 12 inches deep, and in a few places the grayish-yellow subsurface layer extends to 18 or 20 inches. The texture of the subsoil varies from a friable sandy clay loam to rather hard and stiff clay loam. Woodstown soils resemble the Norfolk in color characteristics but can be distinguished by their heavier and browner subsoil and sandier substratum. As typically developed farther south, the Norfolk soils are grayer in the surface and yellower in the subsoil. Norfolk soils

in this area have an element of brown in the surface soil and subsoil that is not characteristic of that series.

A total of 3,520 acres occurs in the northwestern part of the county on nearly flat relief broken only by slight depressions and on slight ridges or knolls surrounded by imperfectly or poorly drained soils. Many areas are large and some form a narrow continuous belt adjoining Sassafras soils, separating them from less well-drained areas. This type has developed from sandy marine deposits, and surface and internal drainage are good but not excessive. An adequate supply of moisture is insured for growing crops, as the sandy surface soil absorbs the average rainfall, the heavy subsoil prevents excessive leaching, and the water table remains near the surface—at a depth of about 3 feet during much of the year.

About 75 percent of the area is cultivated, mainly for green truck crops. Many areas produce two crops of spinach or one of kale or collards (pl. 4, *A*), in winter, and snap beans, cabbage (pl. 4, *B*), or corn in spring and summer. Many spinach growers sow cowpeas, soybeans, or millet in summer as a soil-improving crop. Spinach yields 350 to 500 baskets an acre, kale and collards 600 to 900 bushels, snap beans 50 to 150 bushels, peas 75 to 150 bushels, cabbage 4 to 10 tons, and corn 35 to 40 bushels.

Spinach requires a medium to slightly acid soil for proper growth, and most growers apply 1,000 to 2,000 pounds an acre of ground dolomitic limestone once each 2 or 3 years. For spinach, snap beans, and peas, 500 to 1,000 pounds of 3–10–6 or 6–6–5 are applied when planting. Additional side dressings or top dressings of 500 pounds of 9–5–4 or 200 to 300 pounds of nitrogen salt are added for spinach during the growth of the crop. Snap beans are side-dressed at blossoming time with nitrate of soda. When spinach is planted following a fertilized crop or when the soil test shows a high content of available phosphoric acid and potash, no fertilizer is applied but top dressings are made after thinning. Kale, collards, and cabbage require a fertilizer with a high nitrogen content, and it is a common practice to apply 500 to 1,000 pounds of 6–8–6 with the seed and then to top-dress with 500 pounds of 10–5–5 or 200 pounds of a nitrogen salt. Corn and green-manure crops are not commonly fertilized, as they follow heavily fertilized crops.

Included with this soil type in mapping are a few areas where the surface layer is loamy fine sand and the subsoil a slightly compact fine sandy loam or sandy loam. These areas frequently occupy low narrow ridges separating areas of imperfectly or poorly drained soils, as in the vicinity of Bonneys Corner about 2 miles southwest of Kempsville. In a few places the surface soil texture is very fine sandy loam. In many of the larger bodies some very small depressional areas of Dragston soils also have been included, as they are too small, in many places less than one-fourth acre, to show on a map of the scale used.

Woodstown sandy loam.—The surface soil to a depth of 6 or 9 inches is grayish-brown loose or friable sandy loam or coarse sandy loam with a few small particles of gravel in many places. When dry, the surface has a grayish-yellow appearance. The subsurface layer to a depth of 12 or 16 inches is grayish-yellow firm sandy loam. The subsoil is brownish-yellow or grayish-yellow moderately friable but rather stiff sandy clay loam or clay loam to a depth of 24 or 30 inches.

The lower subsoil extends to a depth of 36 or 40 inches and is faintly mottled grayish-yellow, brownish-yellow, and gray friable sandy loam that becomes highly mottled and predominantly gray in the lower part. The substratum is gray or mottled gray, grayish-yellow, and rust-brown sticky sand, coarse sand, and gravel. The surface layers are structureless, but the subsoil can be separated into soft irregular angular aggregates a fourth to half an inch on a side. In a few small areas, one of which is near Burtons, there is 30 percent or more of small gravel in the subsoil and substratum. The entire profile is extremely to very strongly acid.

The total of 1,280 acres mapped is found on nearly flat relief only in the northwestern part of the county, in most places associated with sandy loams of the Sassafras and Dragston series. Developed from sandy marine deposits, the surface and internal drainage are good but not excessive, and the water table stands at a depth of about 3 feet much of the year. The sandy surface soil absorbs most of the rainfall, and the heavy subsoil prevents much plant nutrient from leaching out.

About 75 percent of this soil is cultivated to green truck crops. It is adapted to the same crops as Woodstown fine sandy loam and is managed and fertilized in the same manner. Crop yields, especially of spinach, are slightly lower in some years, as winter-killing is more severe than on the fine sandy loams. Spinach yields about 300 to 425 baskets an acre, kale 500 to 800 bushels, snap beans 50 to 150 bushels, peas 75 to 150 bushels, cabbage 4 to 8 tons, and corn about 35 bushels.

Woodstown silt loam.—In cultivated fields the surface soil to a depth of 6 or 8 inches is grayish-brown friable silt loam. The subsurface to a depth of 10 or 15 inches is grayish-yellow or yellowish-gray slightly compact silt loam faintly streaked with rust brown. The subsoil to a depth of 20 or 30 inches is grayish- or brownish-yellow silty clay loam or clay, hard but somewhat friable under average moisture content but sticky and plastic when wet. The lower subsoil to a depth of 36 or 44 inches is mottled gray, grayish-yellow, and yellowish-brown sandy clay. The substratum is mottled gray and grayish-yellow sticky sand with a few small gravel particles in many places. The entire profile is very strongly acid.

In wooded areas the surface soil is dark grayish-brown silt loam to a depth of 4 or 5 inches. In some places the lower subsoil is predominantly gray, and the substratum is reached at a depth of 30 inches. This type resembles Craven silt loam in many features, without its stiff clay or clay loam subsoil and substratum.

The total of 1,152 acres mapped in the northwestern part of the county occupies nearly flat relief, and many individual areas are large. It has developed from marine deposits and is well drained.

About 75 percent of this soil is cultivated principally for spinach and other green vegetables. This heavier soil is preferred by many growers of winter spinach, as winter-killing appears to be less severe than on the lighter soils. The crop must be sown early, to have the root system well established before cold weather. A disadvantage is that there may be wet periods of 2 weeks or more when it is impossible to thin, fertilize, or harvest the crop. Spinach yields about 250 to 400 bushels an acre, kale and collards 600 to 800 bushels, cabbage 4 to 8 tons, snap beans 50 to 150 bushels, and corn 35 bushels. Snap beans,

cabbage, and corn are grown in spring and summer, but many farmers plant cowpeas, soybeans, millet, or other soil-improving crops.

The land for spinach receives 500 to 800 pounds an acre of 3–12–6 or 6–8–6 at planting time unless the preceding crop was heavily fertilized. In such cases no fertilizer is applied until the crop is thinned or has a fair growth, and then a top dressing is made of 500 pounds of 10–5–5 or 200 to 300 pounds of nitrogen salt. The land for snap beans receives 500 pounds of 3–12–6 or 6–8–6 when it is ready for planting and is side-dressed with 200 pounds of nitrate of soda when the beans are flowering. Kale, collards, and cabbage receive 500 pounds of 6–8–6 when planted and are side-dressed one or more times with 500 pounds of 10–5–5 or 200 to 300 pounds of nitrogen salt. Corn and soil-improving crops are not fertilized.

LAND USE AND SOIL MANAGEMENT[6]

Practically all the soils of Princess Anne County are capable of producing good yields of general farm crops if properly drained and cultivated. A much greater income can be obtained, however, by growing vegetables on soils particularly suited to them. As a result, only the poorly drained soils of the Bladen, Elkton, Fallsington, Bayboro, Portsmouth, and Hyde series are extensively used in the independent production of general farm crops. Corn, soybeans, and oats are the most important general farm crops and, from the standpoint of acreage, the most important.

A total of 13,804 acres of truck crops was planted for harvest in 1939, in order of importance as follows: Potatoes, spinach, snap beans, sweetpotatoes, strawberries, kale, cabbage, peas, collards, tomatoes, radishes, cucumbers, lima beans, turnips, and cantaloups; with small additional acreages in beets, watermelons, squash, broccoli, carrots, cauliflower, eggplant, lettuce, okra, onions, parsnips, peppers, pumpkins, rutabagas, and salsify.

The production of spinach and strawberries has increased to some extent in the past few years; that of kale and cabbage has been considerably reduced. Acreages of other truck crops have remained fairly constant.

The county has two fairly distinct trucking areas, one in the southeastern, the other in the northern part. On the southeastern fine sandy loam soils of the Sassafras, Norfolk, and Moyock series on the Pungo Ridge and on Fallsington fine sandy loam and Portsmouth loam bordering the ridge, potatoes, early peas, fall snap beans, and sweetpotatoes are the principal truck crops. In the northern district, extending southward about 5 miles from Chesapeake Bay, spinach, kale, collards, cabbage, and snap beans are the principal truck crops grown on the fine sandy loam of the Sassafras series, the sandy loams of the Woodstown and Dragston, and the silt loams of the Woodstown and Dragston, all particularly well adapted to spinach, kale, and collards. Potatoes are seldom grown in the northern area, as the soils are too heavy to produce the best quality and they scab badly, and because they have been limed sufficiently to grow satisfactory crops of

[6] Data for truck crops furnished by H. H. Zimmerley, director of the Virginia Truck Experiment Station, and that for general field crops by H. W. Ozlin, county agricultural agent.

spinach. Strawberries are grown in both areas and also throughout the county on the heavy types of soils of the Lenoir, Fallsington, and Bladen series. Other truck crops also are grown in other parts on soils of the Norfolk, Lenoir, Elkton, and Bladen series as well as on Sassafras and Woodstown soils.

Experiments conducted over a period of years at the Virginia Truck Experiment Station and on farms in various parts of the county have resulted in the following recommendations on liming, fertilizing, and improving the soil for truck crops.

For additional information and current recommendations the reader is referred to the Virginia Truck Experiment Station, Norfolk, Va., and to the Virginia Agricultural Experiment Station, Blacksburg, Va. The following bulletins of the Virginia Truck Experiment Station are suggested for readers desiring detailed information on truck crops:

44. Spinach Fertilizers. 1923.
48. Spinach Fertilizers, Second Report. 1924.
63. Spinach Fertilization With Synthetic Nitrogen Salts. 1928.
73. Effects of Heavy Applications of Phosphorus on the Inter-relation of Soil Reaction, Growth, and Partial Chemical Composition of Lettuce, Beets, Carrots, and Snap beans. 1930.
77. Fertilizer Ratios of Ammonia, Phosphoric Acid and Potash for Potatoes. 1931.
78. Celery Culture in Eastern Virginia. 1932.
80. Tomato Fertilization—1. Effect of Different Fertilizer Ratios on the Yield of Tomatoes. 1933.
81. Tomato Fertilization—2. The Effect of Different Fertilizer Ratios on the Chemical Composition of Tomatoes. 1933.
83. The Rational Use of Lime in Potato Production in Eastern Virginia. 1934.
89. Magnesium Deficiency. 1935.
91. Liming Coastal Plain Soils. 1936.
93. Control of Cabbage Worms. 1936.
94. Soil Organic Matter Investigations Upon Coastal Plain Soils. 1937.
96. Spinach and Cabbage Seed Treatment. 1937.
98. Use of Rapid Chemical Plant Nutrient Tests in Fertilizer Deficiency Diagnoses and Vegetable Crop Research. 1938.

LIMING

Practically all the virgin soils of the county are very strongly acid. The continued use of acid-forming fertilizers since 1925 has greatly increased the acidity of soils that have not been limed; consequently, it is necessary to apply lime to practically all truck crops to obtain maximum yields.

The various vegetable crops grown in the county are here arranged in three groups, according to their lime requirements, as shown by the soil reaction needed for optimum growth, as follows:

STRONGLY ACID (pH 5.0 to 5.5)

Potatoes	Sweetpotatoes	Watermelons

MEDIUM ACID (pH 5.5 to 6.5)

Beans (lima and snap)	Eggplant	Radishes
Broccoli	Kale	Salsify
Cabbage	Mustard	Squash
Carrots	Parsley	Strawberries
Cauliflower	Parsnips	Sweet corn
Collards	Peppers	Tomatoes
Cowpeas (edible)	Pumpkins	Turnips
Cucumbers		

SLIGHTLY ACID (pH 6.0 to 6.5)

Asparagus	Lettuce	Peas (garden)
Beets	Muskmelons	Spinach
Celery	Onions	Swiss chard
Leeks		

The quantity of lime per acre recommended to bring about a unit change in pH value in the soil to a depth of 6 inches is as follows:

From pH 5.5 to pH 6.5: For sandy loams, 2,000 pounds of calcium oxide (CaO) or magnesium oxide (MgO) equivalent (1¾ to 2 tons of ground limestone or shell lime); for loams or silt loams, 2,000 pounds (2¾ to 3 tons of lime).

From pH 4.5 to pH 5.5: For sandy loams, 1,500 pounds of CaO or MgO equivalent (about 1 ton of lime); for loams or silt loams, 2,000 pounds (2¾ to 3 tons of lime).

If soils are above normal in organic content, a larger quantity of lime than that indicated will be needed. Portsmouth, Bayboro, and like soils may require twice as much lime to bring about a similar change in reaction.

Most truck farmers in the county submit samples of soils to the Virginia Truck Experiment Station for lime-requirement determination before liming. This is particularly necessary if the soil is to be limed for potatoes, because an application of too much may result in serious scab injury to the crop. Previous to 1933 most liming materials used in this section were finely ground oystershells or burned oystershell lime, which are high calcium limes and contain very little magnesium. In recent years, because of magnesium deficiency in most trucking soils and to maintain a desirable content, it has been recommended that the growers use dolomitic forms of lime, which contain considerable quantities of magnesium, or alternate applications of oystershell and dolomitic lime.

FERTILIZER REQUIREMENTS

Many farmers use little or no fertilizer in a rotation of corn and soybeans but depend on the use of soybean residues, lime, and stable manure to improve and maintain the fertility of the soil. Yields can be increased and maintained at a high level if 200 to 500 pounds of 4–12–4 or 4–8–4 is applied to these crops.

Recommendations for the fertilization of the more important vegetable crops in the county are given in table 6.

TABLE 6.—*Kind of fertilizer and rate of application an acre at time of planting for the more important vegetable crops in Princess Anne County, Va.*

Crop	For soils with a low level of productivity		For soils with a high level of productivity	
	Pounds	*Analysis*	*Pounds*	*Analysis*
Beans, snap [1]	800–1,000	5–10–5	500–800	3–12–6
Beans, lima	800–1,000	3–12–6	400–600	3–12–6
Beets [1]	800–1,200	6–8–6	500–800	6–8–6
Broccoli [1]	1,000–1,200	6–8–6	500–1,000	6–8–6
Cabbage (eastern Virginia) [1]	1,000–1,200	6–8–6	500–1,000	6–8–6
Cantaloups	800–1,200	5–10–5	800–1,000	3–12–6
Carrots	800–1,200	6–8–6	500–1,000	6–8–6
Collards [1]	500–1,000	6–8–6	600–800	6–8–6
Corn, sweet	800–1,000	5–10–5	500–800	5–10–5 or 3–12–6
Cucumbers [1]	800–1,000	6–8–6	600–800	6–8–6
Eggplant [1]	800–1,000	6–8–6	600–800	6–8–6
Kale [1]	600–800	6–8–6	500–600	6–8–6
Lettuce [1]	800–1,000	6–8–6	600–800	6–8–6
Onions [1]	800–1,200	6–8–6	800–1,000	6–8–6
Peas	1,000–1,200	6–8–6	800–1,000	6–8–6
Peppers [1]	800–1,200	6–8–6 or 5–10–5	600–800	6–8–6
Potatoes (eastern Virginia)	1,800–2,200	[2] 6–8–6 or 5–10–10	1,800–2,000	6–8–6
Potatoes (other than eastern Virginia)	1,000–1,500	4–12–4	1,000–1,500	4–12–4
Radishes [1]	500–1,000	6–8–6	400–500	6–8–6
Rutabagas	800–1,000	6–8–6	500–800	6–8–6
Spinach [1]	500–800	5–10–5 or 6–8–6	400–600	3–12–6
Squash	800–1,000	6–8–6	400–600	6–8–6
Strawberries (eastern Virginia)	[3] 800–1,000	6–8–6	500–800	6–8–6
Strawberries (other than eastern Virginia)	[3] 600–800	5–10–5	400–500	5–10–5
Sweetpotatoes	[4] 800–1,200	3–3–15	800–1,200	2–8–10
Tomatoes	[5] 500–600	3–12–6	400–500	3–12–6
Turnips	800–1,000	6–8–6	400–600	6–8–6
Watermelons [1]	500–800	5–10–5	300–500	6–8–6

[1] Crop should be side-dressed or top-dressed one or more times with fertilizer of the same analysis as used at planting or with 10–5–5 (400 to 600 pounds an acre), or with nitrate of soda, or with a mixture of nitrate of soda and sulfate of ammonia (200 to 400 pounds an acre). The kind of fertilizer, the quantity, and frequency of application will depend on the soil test, the season, weather conditions, and the quantity of fertilizer used at planting.

[2] Use 5–10–10 on dark-colored soils.

[3] Apply late in September or early in October.

[4] Application should be delayed until 1 week after plants are set unless transplanter is equipped to apply fertilizer in bands 4 to 5 inches on each side of plants.

[5] Side-dress with 500 pounds same-analysis fertilizer 4 to 6 weeks after setting Marglobe or Rutgers varieties and 1 to 2 weeks after setting other varieties.

The fine sandy loam types of the Sassafras, Norfolk, and Woodstown series will require heavier applications of nitrogenous materials, in the form of a side dressing or a top dressing to the growing crop, than will Moyock fine sandy loam or Woodstown and Dragston silt loams and considerably more than Bayboro, Portsmouth, and other dark-colored soils. The quantity of nitrogen needed for a top or a side dressing will also depend on the quantity of leguminous cover crops turned under as well as on the soil type.

Complete fertilizers are commonly used for the different crops as follows:

Potatoes and cabbage, 2,000 pounds an acre; kale, collards, and spinach, 1,200 to 2,000; all other vegetable crops, 800 to 1,000 pounds.

Top-dressing or side-dressing mixtures, as 10–5–5, are used at the rate of 400 to 500 pounds an acre, and nitrate of soda or sulfate of ammonia, at about 200 pounds, the number of applications depending on the previous soil treatment, the quantity of rainfall, the season, and the soil type. The lighter types of soils, including the Sassafras,

Norfolk, and Woodstown fine sandy loams and sandy loams usually require heavier and more frequent top dressing than the heavier types. The dark-colored soils, as Bayboro and Portsmouth, containing considerable quantities of organic nitrogen, usually require much less nitrogen for top dressing than the light-colored soils. Soils that have been kept at a high level of fertility by turning under large quantities of leguminous cover crops each year require less nitrogen than soils that have been continuously planted to cash crops.

The method of applying fertilizer is often as important as the quantity and the analysis of the materials used. Extensive experiments with the more important vegetable crops have shown that fertilizer gives best results with seeded crops if applied by machine in bands 2 inches to the side and 2 to 3 inches below the level of the seed. This is particularly important with peas and beans, both of which are very susceptible to fertilizer injury. Proper band placement has sometimes increased yields of the crops more than 50 percent above the yields under methods commonly followed.

ORGANIC MATTER

Satisfactory yields of vegetable crops cannot be maintained on the light-colored soils without frequent addition of organic matter. Since very little stable manure is available, growers must depend on turning under green-manure crops. The green-manure crop best suited for a given soil depends on the season, the cash crop that follows, the degree of soil acidity, and the level of soil fertility. Clover, vetch, cowpeas, soybeans, and other legumes are recommended for soils low in nitrogen. Nonlegumes, as sorghum or millet, may be successfully used as a summer crop for soil improvement following a heavily fertilized crop in order to obtain a relatively large quantity of organic matter in a short period. On Woodstown soils at the Virginia Truck Experiment Station, sorghum, soybeans, a mixture of soybeans and sorghum, cowpeas, and sown field corn all gave equally good results as summer crops for soil improvement. For seeding in September and early October, crimson clover, vetch, or mixtures of these with rye gave excellent results on well-limed soils. Rye is an excellent winter cover crop to be turned under in February before potatoes are planted. Clover does not grow well on acid potato soils, but other legumes, as soybeans and cowpeas, make good growth. Soybeans cut for hay deplete the soil fertility, but they are a satisfactory crop for soil improvement if the entire crop is plowed under or if it is allowed to mature and the beans are harvested, and crop residues are left on the land.

CROP ROTATION

In the potato-growing area, potatoes are usually followed the same year by soybeans for seed, by corn, or by fall snap beans, and sometimes by rye to be plowed under before potatoes are planted the following spring. A good 2-year rotation is potatoes followed by soybeans for seed the first year, and corn with soybeans sown between the rows as a green-manure crop the second year. If sweetpotatoes are to be included, corn followed by rye as a cover crop the first year, sweetpotatoes followed by rye the second year, and potatoes followed by soybeans the third year is a good rotation. In potato rotations rye should be used each year as a winter cover crop.

In a general trucking area where spinach, kale, cabbage, and snap beans are the principal crops a number of satisfactory rotations are possible. As most of these crops are grown in fall, winter, and early spring, it is necessary to grow green-manure crops in summer. Late fall, winter, or early spring crops, as kale, collards, or spinach, are followed by a cover crop of soybeans, cowpeas, millet, or sorghum, which are plowed under in midsummer or fall and followed by spinach, cabbage, kale, collards, or broccoli. Spinach can be successfully grown year after year in the same field unless the wilt disease becomes serious. The crucifers—kale, collard, and cabbage—should not be planted continuously, because of the danger of serious loss from black rot and yellows.

Cucumbers and cantaloups are sometimes planted for a summer crop instead of green-manure crops, especially if the land is to be planted in early-fall spinach, which does not grow well immediately after a green-manure crop has been turned under.

Another common rotation is spinach, kale, or collards, followed by corn with soybeans grown between the rows, followed by spinach planted in November or December for spring harvest. Spring cabbage is often followed by a soil-improvement crop, after which the land is planted in November to spinach. Strawberries usually follow kale or collards and are allowed to remain 2 years and then are followed by kale, collards, or spinach. The heavy growth of grass and weeds in the strawberries the second year serves as a soil-improvement crop. This practice is not recommended for the Blakemore variety, which seldom produces a good crop of berries the second year.

It is recommended that at least one heavy green-manure crop be turned under every second year irrespective of the rotation followed, and more frequently if possible.

A good 2-year rotation for general farm crops is corn, followed by winter oats for grain or hay; and soybeans the second year, followed by winter oats, rye, or crimson clover to be plowed under before planting corn again.

CROP VARIETIES

The principal varieties of the many truck crops grown in the county are as follows:

Snap beans—Bountiful, Asgrow Stringless Greenpod, Tendergreen, and Sure Crop Wax.
Lima beans—Fordhook.
Cabbage—Early Jersey Wakefield for spring harvest (which will likely be replaced by Early Flat Dutch in the near future), and All Head Early for fall crop.
Collards—Cabbage Heading.
Cucumbers—Straight Eight and A. and C.
Cantaloups—Bottomley, Long John, and Hale Best.
Kale—Dwarf Blue Scotch (pl. 5, *A*) for winter and Siberian for early spring.
Peas—Thomas Laxton and Laxtonian.
Potatoes—Irish Cobbler.
Radishes—Scarlet Globe.
Spinach—Virginia Savoy, Old Dominion (pl. 5, *B*), and Bloomsdale.
Sweetpotatoes—Porto Rico and Nancy Hall.
Strawberries—Missionary and Blakemore.

The most common varieties of field crops are as follows:

White corn—Horsetooth and Palmetto.
Yellow corn—Virginia Golden Dent.
Soybeans—Tokyo, Dixie, and Hollybrook.
Oats—Fulghum.

CONTROL OF INSECT PESTS

The principal insects of the crucifers—cabbage, kale, and collards—are larvae of the diamondback moth, cabbage looper, and imported cabbage worm, which can be controlled by dusting with an arsenical when the plants are small and treating with rotenone dusts or sprays when plants are nearing maturity. Aphids can be controlled by dusting with a 3-percent nicotine dust.

Snap beans and lima beans are frequently subject to severe infestation by the Mexican bean beetle, which can readily be controlled by spraying or dusting with rotenone, provided the dusts or sprays are properly applied to cover the under sides of the bean leaves (pl. 6, *A*). The spinach crop is often infested with aphids that can be controlled by the proper application of 3-percent nicotine dust. Early fall spinach is frequently attacked by the beet webworm, but if planting is delayed until after the first of September this will usually prevent heavy infestation.

The limiting factor in the production of garden peas, particularly the fall crop, is injury by the pea aphid. This insect is not so readily controlled by nicotine dusts as are the aphids of other crops. Vaporizing nicotine with special equipment under a gas-tight cloth trailer drawn slowly over the vines has been the most effective method for controlling pea aphids. The potato crop must be given one or more treatments with arsenicals for the control of the Colorado potato beetle.

Red spiders cause considerable damage to strawberries, beans, and many other crops. They can be controlled by dusting with finely ground dusting sulfur when temperatures are above 70° F., except on cantaloups and other cucurbits, where sulfur dust is injurious. Flea beetles, which attack a variety of crops, can be best repelled or controlled by spraying with a bordeaux-calcium-arsenate dust or by dusting with a copper-lime-calcium arsenate dust. Cutworms and army worms, which are at times exceedingly destructive, can be controlled by poison bran baits moistened with cylinder oil.

CONTROL OF CROP DISEASES

Many diseases of vegetable crops can be prevented by proper crop rotations, using disease-free seed, treating the seed, and planting resistant varieties. Local-grown kale or collard seed should always be given corrosive sublimate treatment to eliminate the black rot bacteria and should be planted only in fields in which kale, collard, cabbage, and related plants have not been grown for several years. Specific directions for seed treatment of the more important vegetable crops grown in this county may be obtained from Farmers' Bulletin 1862, Vegetable Seed Treatments, published by the United States Department of Agriculture.

Mildew on cantaloups and cucumbers, locally called rust, can be checked to some extent by spraying with bordeaux mixture or dusting with a copper-lime dust (pl. 6, *B*). No treatment has yet been found for the control of spinach mildew, commonly called blue mold, and fusarium wilt. Breeding for resistance to these diseases has been undertaken at the Virginia Truck Experiment Station.

Powdery mildew, which is often destructive to the fall crop of snap beans, is easily controlled by dusting or spraying the plants with sulfur as soon as the disease appears and repeating the treatment at 10-day

to 2-week intervals for the rest of the season. A combination of rotenone and sulfur dust or spray may be used to control both mildew and the Mexican bean beetle at the same time. Bean rust may be partly checked with the sulfur applications that are used for mildew, but they will not control it. Fall potatoes are sometimes damaged by late blight. This may be controlled by spraying with bordeaux mixture or dusting with copper-lime dust.

PLANTING AND HARVESTING

The crop season and planting and harvesting dates of the principal vegetable crops for the county are given in table 7.

TABLE 7.—*Crop season and planting and harvesting dates of the principal vegetables for Princess Anne County, Va.*

Vegetable	Season	Planting period	Harvesting period
Beans, snap	Spring	Mar. 1–Apr. 15	May–June.
Do	Fall	Aug. 1–20	Oct.–Nov.
Beans, lima		Apr. 15–Aug. 1	July–Nov.
Beets	Spring	Mar. 1–30	June–July.
Do	Fall	July 15–30	Oct.–Dec.
Broccoli		July 1–15	Do.
Brussels sprouts		June 15–Aug. 1	Oct.–Mar.
Cabbage	Spring	Sept. 25–30	May–June.
Do	Fall	June 15–Aug. 1	Sept.–Mar.
Cantaloups		Apr. 15–May 15	Aug.–Sept.
Do		Mar. 20–30 [1]	July–Aug.
Carrots	Spring	Mar. 1–30	Do.
Do	Fall	July 15–30	Oct.–Dec.
Collards		July 15–Aug. 15	Oct.–Mar.
Cucumbers		Apr. 1–May 15	July–Aug.
Kale		July 25–Aug. 10	Nov.–Mar.
Lettuce	Fall	Aug. 1–20	Oct.–Nov.
Peas	Spring	Feb. 15–Mar. 15	May–June.
Do	Fall	Aug. 20–Sept. 10	Oct.–Nov.
Potatoes		Feb. 15–Mar. 15	June–July.
Radishes		Jan. 15–Mar. 15	Mar.–May.
Rutabagas		July 15–Aug. 15	Nov.–Mar.
Spinach	Spring	Oct. 10–Mar. 1	Mar.–May.
Do	Fall	Sept. 1–20	Nov.–Dec.
Squash, bush		Apr. 1–May 1	June–July.
Sweetpotatoes		Mar. 15–Apr. 15 [2]	Aug.–Oct.
Tomatoes	Early	Mar. 1 [1]	June–July.
Do	do	Apr. 1 [3]	July–Sept.
Do	Fall	June 1–30	Oct.–Nov.
Turnips	Spring	Mar. 15–Apr. 15	May–June.
Do	Fall	July 1–Sept. 1	Sept.–May.

[1] Under glass. [2] Bedded. [3] In field.

DRAINAGE

The soils in the county are classified according to drainage as well drained, imperfectly drained, and poorly drained. Those well drained are adapted to all crops and do not need artificial drainage; the imperfectly drained can be cultivated without supplementary drainage, but during wet seasons crops may drown or planting and harvesting may be so much delayed that profitable yields cannot be realized; the poorly drained, both light- and dark-colored, cannot be cultivated unless artificial drainage is maintained.

All artificial drainage consists of canals and open ditches. Tile laid on a few farms has been unsatisfactory because the impervious nature of most subsoils prevents the percolation of water, and the most important function of a drainage system in this area is the removal of surface water. Open ditches properly laid out are adequate and

inexpensive. As there are no stones or hardpan subsoils in the county, the clay subsoils can be easily excavated with a spade. The only obstructions encountered are stumps and roots, and these can be readily chopped out. The canals or lead ditches need not be long, as no point in the county is more than 8 miles from a stream or inlet at or near sea level. These ditches constitute a permanent improvement, for once dug they remain indefinitely, as there is very little freezing and thawing in winter and the subsoils have sufficient clay or are sufficiently compact to maintain a straight-sided wall that does not slough. A well-planned ditch system needs no attention other than cleaning every 2 or 3 years and cutting brush and reeds from the banks.

Only a few ditches are necessary to correct imperfect drainage. Many small areas in depressions of a well-drained soil do not need to be drained. Water stands on many of them after each hard rain, however, and this should be removed. A tile drain might be used for this purpose, as an open ditch would hinder tillage on adjoining well-drained soils.

A complete grid of ditches is dug in areas of poorly drained soils, dividing the field into cuts of 2 to 4 acres each. The most satisfactory system consists of long narrow cuts about 100 to 200 feet wide. In most places the lateral ditches are 1½ to 3 feet deep and the lead ditches and canals 5 to 8 feet deep. Most cuts are plowed from the center outward, so that in many places cultivation has worked the soil toward the center and many are 1 or 2 feet higher there than on the edges. This gives the appearance of undulating relief and hastens runoff. Some areas of dark-colored poorly drained soils at a lower level than the surrounding land are difficult to drain, and a deep canal through these areas would be necessary. Many, however, lie at the head of a natural drain and the water can be adequately removed by deepening these natural channels. Most areas of Bladen silty clay loam, swamp phase, lie at such a low elevation that they cannot be reclaimed economically.

ESTIMATED YIELDS

The soils of Princess Anne County are listed alphabetically in table 8, and for each soil there is given the estimated average acre yield of the principal crops under the prevailing practices of farm management.

TABLE 8.—*Estimated average acre yields of the principal crops on the soils of Princess Anne County, Va., under common practices of management* [1]

Soil	Potatoes	Sweet potatoes	Spinach	Kale	Collards	Cabbage	Strawberries	Snap beans		Garden peas	Corn	Soybeans		General suitability for use	Comparative ratings [2]
								Spring	Fall			Dry beans	Hay		
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Qts.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*		
Arzell sand															10
Bayboro silt loam	200						[3] 3,000				[4] 40	[4] 25	[4] 2	Fair for general crops; good for pasture	9
Bladen fine sandy loam (drained) [5]											[4] 25	[4] 20	[4] 1½	do	9
Bladen silt loam (drained) [5]	[3] 150		[3] 300	[3] 500	[3] 500	[3] 6	[3] 2,000				[4] 25	[4] 20	[4] 1½	do	9
Bladen silty clay loam, swamp phase														Best suited for timber	10
Coastal beach															10
Craven fine sandy loam	200	[3] 175	[3] 350	[3] 700	[3] 700	[3] 6	3,000	[3] 100	[3] 50	[3] 125	30	20	1½	Fair for truck crops; good for general crops	3
Craven silt loam	200		[3] 350	[3] 700	[3] 700	[3] 6	[3] 3,000	[3] 100	[3] 50	[3] 125	35	25	2	do	3
Dragston fine sandy loam (drained) [6]			375	700	700	7		125	75	[3] 125	35	25	2	do	3
Dragston sandy loam (drained) [6]			375	700	700	7		125	75	[3] 125	30	20	1½	do	3
Dragston silt loam (drained) [6]			350	600	600	7		100	75	[3] 125	35	25	2	do	5
Dune sand															10
Dune sand, stabilized phase															10
Elkton silt loam	[3] 175		[3] 300	[3] 600	[3] 600	[3] 6	[3] 2,500		[3] 50		[4] 25	[4] 20	[4] 1½	Fair for general crops; good for pasture	8
Fallsington fine sandy loam	200		[3] 300	[3] 600	[3] 600	[3] 6	2,500		[3] 75	[3] 100	[4] 25	[4] 20	[4] 1½	Poor for truck crops; good for general crops	7
Hyde silty clay loam											[4] 40	[4] 25	[4] 2	Poor for general crops; good for pasture	9
Lenoir fine sandy loam (drained) [6]	175	[3] 150	[3] 350	[3] 700	[3] 700	[3] 6	2,500		[3] 60	[3] 100	25	20	1½	Fair for truck crops; good for general crops	5
Lenoir silt loam (drained) [6]	175		[3] 350	[3] 700	[3] 700	[3] 6	2,500		[3] 50		25	20	1½	Poor for truck crops; good for general crops	6
Made land															10
Marsh															10
Moyock fine sandy loam (drained) [6]	200	[3] 150	[3] 350	[3] 700	[3] 700	[3] 6	3,000		70	[3] 100	30	20	1½	Fair for truck crops; good for general crops	4
Norfolk fine sandy loam	200	200	[3] 350	[3] 700	[3] 700	[3] 8	3,000	125	75	125	30	20	1½	Good for truck crops	2
Norfolk loamy fine sand	[3] 125	[3] 150	[3] 200	[3] 400	[3] 400	[3] 5		[3] 100	[3] 40	[3] 75	20	15	1¼	Best suited for timber	10
Pits															10
Portsmouth loam	200										[4] 35	[4] 25	[4] 2	Poor for truck crops except potatoes; good for general crops.	8
Sassafras fine sandy loam	200	200	400	750	750	8	3,000	150	90	125	[3] 35	[3] 25	[3] 2	Good for truck crops	1
Sassafras sandy loam	200	200	400	750	750	8	[3] 3,000	150	80	[3] 125	[3] 30	[3] 25	[3] 2	do	1
Sassafras silt loam	200		[3] 350	[3] 700	[3] 700	[3] 6	3,000	[3] 100	[3] 75		35	25	2	Fair for truck crops; good for general crops	3
Swamp														Best suited for timber	10
Swamp-dune sand complex															10
Tidal marsh															10
Woodstown fine sandy loam			400	750	750	8	3,000	125	75	[3] 125	[3] 35	[3] 25	[3] 2	Good for truck crops	2
Woodstown sandy loam			350	700	700	7	3,000	125	75	[3] 125	[3] 30	[3] 25	[3] 2	do	2
Woodstown silt loam			300	700	700	6	3,000	100	75		[3] 35	[3] 25	[3] 2	Fair for truck crops; good for general crops	3

[1] Common practices of management include heavy applications of commercial fertilizer for truck crops. Refer to text for details.

[2] Comparative for these soils in this county only—on the basis of estimated productivity and suitability for the common crops, the most productive and widely adapted soils being given a rating of 1; the least productive or nonproductive, a rating of 10.

[3] Crop not grown extensively on this soil.

[4] Not generally fertilized when grown separately or as an independent crop.

[5] All areas drained artificially before cultivation.

[6] Most areas drained artificially before cultivation.

All the intensive truck farming soils are productive under the conditions of very heavy applications of fertilizer. Practices do not vary greatly on the different soil types except that sometimes the heavy types receive slightly less fertilizer than those that are sandy.

The usual rate of fertilization is as follows:

Potatoes, 1,600 to 2,000 pounds of 6–8–6.
Sweetpotatoes, 500 to 1,000 pounds of 3–3–15.
Spinach, 500 to 1,000 pounds of 3–12–6 or 6–8–6 at planting and one or more top dressings of 500 pounds of 10–5–5 or 200 to 300 pounds of nitrogen salt (also 1,500 to 3,000 pounds of ground limestone or shell lime on acid soils).
Kale, collards, and cabbage, 500 to 1,000 pounds of 6–8–6 at planting and a side dressing of 500 pounds of 10–5–5 or 200 to 300 pounds of a nitrogen salt.
Strawberries, 500 to 1,000 pounds of 6–8–6.
Snap beans and garden peas, 500 to 1,000 pounds of 5–10–5 or 3–12–6 at planting and 200 pounds of nitrate of soda as a side dressing.
Corn and soybeans, 200 to 500 pounds of 4–12–4 or 4–8–4 when an independent crop; but none following a heavily fertilized crop.

Most of the crops grown in this area are perishable and are marketed the same day harvested; consequently one of the most desirable qualities of a soil is that of producing a crop when the price is high. It must also be possible for heavy trucks to enter the field at any time during the harvesting season. These factors are not shown by the yields and, in some instances, the yield actually harvested is much lower than the potential yield, as the crop may be harvested before maximum growth is obtained. This is because it may be more profitable to market 300 bushels of spinach on a certain day than 400 bushels 2 weeks later.

Another consideration not shown by the yields is that the most important growing season here is from June to September, so that the value of a soil is influenced to a very great extent by its ability to warm up sufficiently to permit growth during the milder winter days. Crops grow more quickly on the well-drained sandy soils of the Sassafras, Woodstown, and Norfolk series than on those that are less well drained or heavier, and in many years a marketable crop is produced 1 or 2 weeks earlier. The poorly drained soils are all artificially drained before they are brought into cultivation. They cannot be used for truck crops, however, except in a few places, for the reason that they remain cold and wet in winter, so that the crops grow very slowly (in many places they drown) and cultural operations cannot be carried on for long periods.

The two right-hand columns of table 8 summarize the information as to the comparative suitability of the soils for various uses or types of farming. The ratings, which are comparative for Princess Anne County only, have been derived from the information gathered in the county relative to the productivity, suitability, and desirability of the soils for the various crops; they represent considered judgment rather than a precise statistical treatment of data.

MORPHOLOGY AND GENESIS OF SOILS

Soil is the product of the forces of weathering and soil development acting on the parent soil material deposited or accumulated by geologic agencies. The characteristics of the soil at any given point depend on (1) the physical and mineralogical composition of the parent material; (2) the climate under which the soil material has accumulated and has existed since accumulation; (3) the plant and

animal life in and on the soil; (4) the relief, or lay of the land; and (5) the length of time the forces of development have acted on the material. The climate, and its influence on soil and plants, depends not only on temperature, rainfall, and humidity, but also on the physical characteristics of the soil or soil material and on the relief, which, in turn, strongly influences drainage, aeration, runoff, erosion, and exposure to sun and wind.

Princess Anne County lies in the Tidewater section of the Coastal Plain and occupies the eastern part of the mainland of Virginia. The eastern part of the county, bordering the Atlantic Ocean and the northern part Chesapeake Bay, lies within the transitional area between the Gray-Brown Podzolic and the Red and Yellow Podzolic soil regions. Marbut [7] places the line dividing these two soil regions through the northern part of this county. Under these conditions it is natural that characteristics of both soil groups should be developed to a minor extent in all soils and that those of one group should be associated with or surrounded by those of the other. In addition to this, the soils have developed from three rather distinct classes of unconsolidated marine deposits. In general, the northern parts are underlain by loose but slightly sticky sand and small gravel, the southern by sandy clay and clayey sand, and the central by clay.

Geologically this region is young, and zonal soils have been developed on only about 20 percent of it. About 29 percent of the area is classified as miscellaneous land types, most of which are soil material rather than definite soils. The remaining 51 percent is in sections that have not been invaded by drainageways and, as a result, the development of a zonal soil profile has been retarded by poor drainage. Soil development under optimum drainage conditions in both solum and substratum is represented by only one soil series (Sassafras), but the soils that are well-drained in surface and subsoil horizons can be considered as zonal. Some other areas have fair surface drainage but poor internal drainage and show slight development of a zonal profile.

Most of the soils have a light-colored surface layer and a low content of organic matter. They have developed under a mixed forest growth of deciduous trees and conifers. In forested areas the surface soil to a depth of 2 to 4 inches is dark gray and may have a relatively high content of organic matter, but, when mixed by cultivation, the dark color is masked by the light-colored subsurface horizons. A few soils are dark gray to black in the surface horizon and have a relatively high content of organic matter.

The soils exhibiting zonal profile development are, in addition to Sassafras, those classified in the Norfolk, Woodstown, and Craven series. Sassafras soils have developed from loose unconsolidated marine deposits of sandy clays and silts with some gravel. They have brown or grayish-brown A horizons, reddish-brown B, and reddish- or yellowish-brown C. A profile of Sassafras sandy loam, studied 1 mile west of Ocean Park, is as follows:

A_1. 0 to 6 inches, brown to dark gray-brown structureless sandy loam. This represents the plowed horizon, as this area was formerly cultivated. pH 4.0.[8]

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[7] MARBUT, C. F. SOILS OF THE UNITED STATES. U. S. Dept. Agr. Atlas Amer. Agr., pt. 3, Adv. Sheets No. 8, 98 pp., illus. 1935.

[8] pH determined by E. R. Purvis, of the Virginia Truck Experiment Station, by the glass-electrode method.

A_2. 6 to 15 inches, grayish-yellow sandy loam, faintly streaked, probably along old root channels, with grayish brown, which gives the horizon a mottled appearance. pH 4.1.

B_2. 15 to 27 inches, reddish-brown friable clay loam with some sand. Soft crumb structure. pH 5.1.

B_{21}. 27 to 38 inches, reddish-brown to yellowish-brown friable clayey sand. Soft crumb structure very weakly developed. pH 5.0.

C. 38 to 60 inches, yellowish-brown slightly coherent loamy sand, in some places with a high content of small gravel and coarse sand, especially at depths of more than 5 feet. pH 4.5.

In the southern part of the county some areas of Sassafras resemble the Ruston soils developed in other parts of the Coastal Plain to the south. The A horizon is grayer than typical for Sassafras soils and the C is friable sandy loam or clayey sand somewhat similar in consistence to that of the Norfolk soils.

The other soils exhibiting zonal profile development have gray to grayish-brown A horizons, yellow to brownish-yellow B horizons, and mottled gray, grayish-yellow, and rust- or reddish-brown C horizons. This profile is illustrated by Woodstown sandy loam. A typical description of this soil, as observed half a mile west of Little Creek, is as follows:

A_1. 0 to 3 inches, dark-gray to grayish-brown sandy loam having a large quantity of organic matter. pH 4.3.

A_2. 3 to 13 inches, grayish-yellow structureless sandy loam, slightly sticky. pH 4.6.

B_2. 13 to 21 inches, grayish-yellow structureless sandy clay loam, with some spots of brownish-yellow B_2 and grayish-yellow A_1 that give the appearance of slight mottling. This is a transition horizon. pH 4.5.

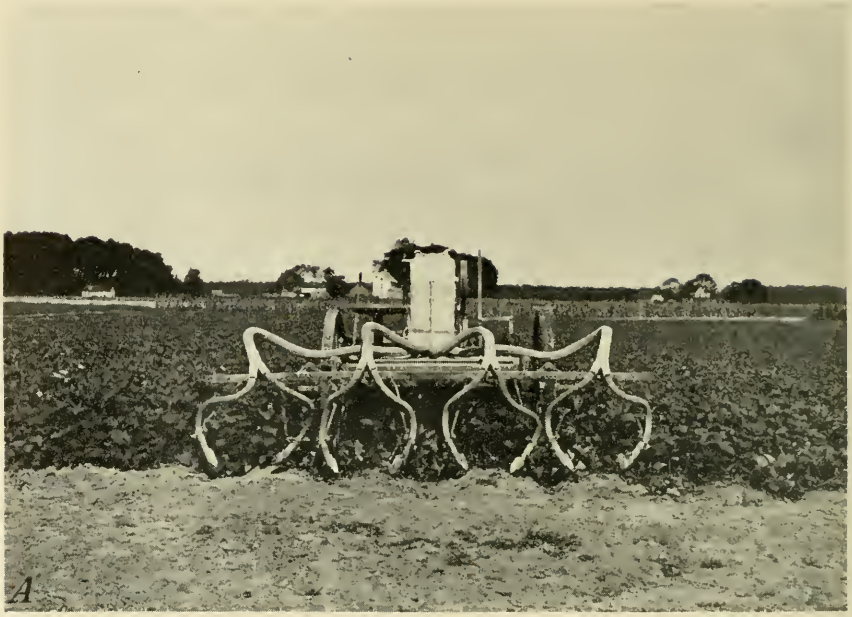
B_{21}. 21 to 34 inches, brownish-yellow friable sandy clay loam to clay loam, soft and sticky when wet. Blocky structure weakly developed, as soil mass breaks into soft irregular angular aggregates about half an inch on a side. pH 4.8.

B_3. 34 to 42 inches, grayish-brown sandy clay loam, in many areas mottled gray, grayish yellow, and grayish brown. Blocky structure weakly developed, as soil mass breaks into soft irregular angular aggregates about half an inch on a side. pH 4.7.

C. 42 to 54 inches, gray to slightly brownish-gray sticky sand, saturated with water much of the year. pH 4.6.

The A and B horizons of these soils are leached of bases and alkaline earths. Much of the iron, aluminum, and colloid has been leached from the A horizons and partly deposited in the B, which results in a relative increase of silica in the A, and of iron, aluminum, and clay in the B. The soils in this group can be distinguished from one another comparatively easily. Sassafras soils are readily identified by the reddish color of the B horizon. The other three are distinguished mainly on textural differences in the B and C horizons. Norfolk soils have developed from sandy clay or clayey sand and have lighter textured B horizons than Woodstown or Craven. Craven soils have developed from silt, fine sand, and clay and have a heavier, stiffer B horizon than Norfolk and a heavier C horizon than either Norfolk or Woodstown. The B horizon of Craven and Woodstown soils is similar in many places, but in most places that of Woodstown soils is lighter and more friable. Norfolk and Craven soils, as developed in this area, are not exactly similar to those mapped in North Carolina and other parts of Virginia, as they show more influence of the Gray-Brown Podzolic soil-forming processes in that in many places they are grayish brown in the A horizon and brownish yellow in the B.

A, Special strain of Dwarf Blue Scotch kale grown by the Virginia Truck Experiment Station on Woodstown fine sandy loam. Dragston fine sandy loam in background. *B*, Old Dominion spinach in early spring on Sassafras fine sandy loam. This field yielded 600 bushels an acre.



A, Nozzle arrangement on duster to control the Mexican bean beetle on snap beans growing on Woodstown find sandy loam. Dragston fine sandy loam in background. *B*, Dusting cantaloups to control mildew on Sassafras fine sandy loam.

The mechanical analysis of a sample of Sassafras fine sandy loam [9] from Accomac County, Va., is given in table 9.

TABLE 9.—*Mechanical analysis of a sample of Sassafras fine sandy loam from Atlantic, Accomac County, Va.*[1]

Sample No.	Horizon	Depth	Material and diameter of particles (in millimeters)						
			Fine gravel (2.0–1.0)	Coarse sand (1.0–0.5)	Medium sand (0.50–0.25)	Fine sand (0.25–0.10)	Very fine sand (0.10–0.05)	Silt (0.050–0.005)	Clay (0.005–0)
		Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
29419	A	1½–10	0.4	2.2	3.7	49.4	6.0	31.4	6.8
29420	B	13–34	0	1.2	2.4	48.0	4.9	13.5	29.8
29421	C	34–53	0	1.3	2.9	75.2	7.4	6.7	6.6

[1] MARBUT, C. F. SOILS OF THE UNITED STATES. U. S. Dept. Agr. Atlas Amer. Agr., pt. 3, Adv. Sheets No. 8, p. 31. 1935.

The sample from Atlantic, Va., has a well-defined color and texture profile. The mechanical analysis shows the percentage of clay in the A, B, and C horizons to be 6.8, 29.8, and 6.6 percent, respectively. The chemical analysis (table 10) shows an apparent accumulation of aluminum in the B horizon and of silica in the A horizon.

The chemical analysis of Sassafras fine sandy loam,[10] table 10, compared with Norfolk fine sandy loam in table 12 shows a much higher percentage of Fe_2O_3, CaO, MgO, K_2O, Na_2O, and P_2O_5 in the former. This clearly indicates that the fine sandy loam in the Sassafras series is inherently a stronger and richer soil than that in the Norfolk.

TABLE 10.—*Chemical analysis of Sassafras fine sandy loam from Atlantic, Accomac County, Va.*[1]

Sample No.	Horizon	Depth	SiO_2	TiO_2	Fe_2O_3	Al_2O_3	MnO	CaO	
		Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	
29419	A	1½–10	*a*85.96	0.59	1.74	6.26	0.04	0.40	----------
			*b*87.61	.60	1.77	6.38	.04	.41	----------
29420	B	13–34	*a*81.05	.59	3.21	9.13	.03	.20	----------
			*b*83.38	.61	3.30	9.39	.03	.21	----------
29421	C	34–53	*a*87.38	.41	1.26	6.32	.01	.46	----------
			*b*88.39	.41	1.27	6.39	.01	.46	----------

Sample No.	Horizon	Depth	MgO	K_2O	Na_2O	P_2O_5	SO_3	Ignition loss	N
		Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
29419	A	1½–10	*a*0.36	1.54	0.58	0.02	0.07	1.91	0.02
			b.37	1.57	.59	.02	.07	----------	----------
29420	B	13–34	*a*.40	1.65	.49	.02	.05	2.80	.02
			b.41	1.70	.50	.02	.05	----------	----------
29421	C	34–53	*a*.18	1.75	.76	.01	.05	1.15	.01
			b.18	1.76	.77	.01	.05	----------	----------

[1] MARBUT, C. F. SOILS OF THE UNITED STATES. U. S. Dept. Agr. Atlas Amer. Agr., pt. 3, Adv. Sheets No. 8, p. 31. 1935.

[9] Although the soil is classed as Sassafras sandy loam in the Atlas of American Agriculture, the mechanical analysis reveals it to be definitely a fine sandy loam, and in comparing the data with those of Norfolk fine sandy loam this soil should be considered as a fine sandy loam.

[10] See footnote 7, p. 51.

The mechanical analysis [11] of Norfolk fine sandy loam 3 miles north of Bests, Wayne County, N. C., is given in table 11. Two outstanding features are shown by these data: (1) The extent to which the clay has been transferred from the A horizon to both the lower horizons and (2) the uniform content of silts and sands in the three horizons. This latter fact becomes obvious when the percentages of the silts and sands are figured on a clay-free basis. The large quantity of this coarser material and its uniform distribution throughout the profile, together with the low water table, no doubt have contributed to the transfer of the clay from the upper part of this soil.

TABLE 11.—*Mechanical analysis of Norfolk fine sandy loam* [1]

Sample No.	Horizon	Depth	Material and diameter of particles (in millimeters)				
			Fine gravel (2.0–1.0)	Coarse sand (1.0–0.5)	Medium sand (0.50–0.25)	Fine sand (0.25–0.10)	
		Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
C294	A	0–12	1.7	6.6	9.9	25.9	
C295	B	12–34	1.0	5.1	7.7	20.4	
C296	C	36–80	1.2	4.8	7.9	19.7	

Sample No.	Horizon	Depth	Material and diameter of particles (in millimeters)				Organic matter by H_2O_2
			Very fine sand (0.10–0.05)	Silt (0.050–0.005)	Clay (0.005–0.002)	Colloid (0.002–0)	
		Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
C294	A	0–12	17.8	28.4	8.9	4.9	0.07
C295	B	12–34	14.0	22.7	28.8	23.5	.02
C296	C	36–80	13.7	21.3	31.3	30.1	0

[1] Determinations by laboratories of Bureau of Plant Industry, Soils, and Agricultural Engineering.

The chemical analyses of the three horizons of Norfolk fine sandy loam are given in table 12. The variations in this soil profile are characteristic of a mature profile developed under good drainage and oxidation. This is evidenced by the structure, color, and location of the clay, as pointed out in the description of the soil and by its mechanical analysis. The chemical data given in the table show a pronounced transfer of the major constituents from the A horizon to the lower horizon, as indicated by decrease of silica and increase of sesquioxides. The nature of this transfer is better interpreted from the subsequent data on the colloidal fraction of this soil (table 13). The whole soil has a very low yet uniform content of the minor constituents.

[11] HOLMES, R. S., HEARN, W. E., and BYERS, H. G. THE CHEMICAL COMPOSITION OF SOILS AND COLLOIDS OF THE NORFOLK AND RELATED SOIL SERIES. U. S. Dept. Agr. Tech. Bul. 594, 33 pp., illus. 1938.

TABLE 12.—*Chemical analysis of Norfolk fine sandy loam*[1]

Sample No.	Horizon	Depth	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	MnO	CaO	MgO	
		Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	
C294	A	0–12	94.26	1.01	2.08	0.69	0.01	0.07	0.03	
C295	B	12–34	82.67	1.14	8.87	3.18	.01	.08	.02	
C296	C	36–80	78.99	1.05	11.03	4.45	.02	.01	.05	

Sample No.	Horizon	Depth	K_2O	Na_2O	P_2O_5	SO_3	Ignition loss	pH	N	Organic matter
		Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*		*Percent*	*Percent*
C294	A	0–12	0.03	0.01	0.01	0.01	1.67	5.1	0.02	0.89
C295	B	12–34	.07	.01	.02	.02	3.64	4.6	.03	.40
C296	C	36–80	.02	.03	.01	.03	4.18	4.6	.02	.24

[1] Determinations by laboratories of Bureau of Plant Industry, Soils, and Agricultural Engineering.

TABLE 13.—*Chemical analysis of the colloid of Norfolk fine sandy loam*[1]

Sample No.	Horizon	Depth	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	MnO	CaO	
		Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	
C294	A	0–12	35.97	1.23	32.14	10.70	0.01	0.35	
C295	B	12–34	37.54	1.10	34.41	12.41	.01	.50	
C296	C	36–80	38.73	.90	34.10	11.97	.01	.28	

Sample No.	Horizon	Depth	MgO	K_2O	Na_2O	P_2O_5	SO_3	Ignition loss	Organic matter
		Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
C294	A	0–12	0.58	0.52	0.18	0.10	0.12	17.83	4.65
C295	B	12–34	.52	.53	.27	.10	.11	14.03	1.06
C296	C	36–80	.42	.30	.20	.07	.09	14.29	.77

[1] Determinations by laboratories of Bureau of Plant Industry, Soils, and Agricultural Engineering.

The soils developed under fair surface drainage and poor internal drainage are classified in the Lenoir, Moyock, and Dragston series. This degree of development is illustrated by Lenoir silt loam. A sample of this type, studied 3 miles south of Virginia Beach, is described as follows:

$A_{2\,1}$. 0 to 3 inches, gray to dark-gray or grayish-brown silt loam; root channels dark gray, giving appearance of mottling. (About ½ inch of nearly black silt loam with high content of organic matter A_1 on the surface was not sampled.) pH 4.5.

$A_{2\,2}$. 3 to 8 inches, mottled gray and grayish-brown silt loam. pH 4.4.

B. 8 to 19 inches, mottled brownish-yellow, rust-brown, and gray clay, breaking into irregular angular aggregates about ¼ inch on a side. Many of these aggregates are coated with gray or yellowish-gray silt and the interiors are rust brown. pH 4.6.

C. 19 to 30 inches, stiff plastic gray clay mottled with yellowish brown. pH 4.5.

The A and B horizons of these soils show some evidence of eluviation and illuviation, but not to the extent of the better drained soils. The B horizons are mottled, at least in the lower part, and the C horizons are very highly mottled gray, grayish yellow, and rust brown. The other members of this group are distinguished by the texture of the B and C horizons. Moyock soils are lighter textured in the B horizon than either Lenoir or Dragston and are lighter than Lenoir but heavier than

Dragston in the C horizon. Dragston soils are lighter than Lenoir in both the B and C horizons and have heavier B but sandier C horizons than Moyock.

The soils developed under very poor drainage are classified in the Bladen, Elkton, Fallsington, Bayboro, Portsmouth, and Hyde series. Of these, the first two have gray surface and subsoils and the others black surface and gray subsoils. The light-colored members of this group are illustrated by an example of Bladen silt loam studied half a mile northwest of Sigma.

1. 0 to 1 inch, dark-gray to gray heavy silt loam. In many places this horizon is 3 or 4 inches thick and also in many places it is very silty. pH 4.0.
2. 1 to 16 inches, gray sticky soft silty clay loam to clay. In many places this horizon is mottled with grayish yellow and is very silty.
3. 16 to 30 inches, mottled gray, grayish-yellow, and rust-brown stiff plastic clay or silty clay loam.

The mechanical analysis of a representative profile of Bladen silt loam is given in table 14.

TABLE 14.—*Mechanical analysis of Bladen silt loam*

Sample No.	Depth	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
	Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
213040	0–1	0.2	0.4	1.2	3.7	3.7	71.4	19.4
213041	1–16	0	.2	.7	2.6	2.3	61.6	32.6
213042	16–30+	0	.2	.8	2.9	2.5	63.5	30.1

Elkton soils are distinguished from Bladen soils on the basis of a sandy substratum and by layers or lenses of sand throughout the soils. Also, in most places Elkton soils have a soft sandy clay or clay loam subsoil. Fallsington soils have sandy surface soils and substrata. Bayboro soils resemble Bladen in subsoil characteristics but have a dark-gray to black surface soil that extends to a depth of 12 to 18 inches. Portsmouth soils have a very dark-gray to black surface soil to a depth of 12 to 18 inches, gray or mottled gray, grayish-yellow, and rust-brown soft sandy subsoil and mottled gray, grayish-yellow, and rust-brown sandy clay or clayey sand substratum. Hyde soils have a very dark-gray to black mucky surface soil to a depth of 10 to 15 inches, very dark-gray stiff clay or clay loam subsoil to 20 to 30 inches and a steel- or bluish-gray clay substratum.

Another way in which these soils may be studied is by grouping the soil series in catenas, or groups of soils developed under the same climatic conditions, under different drainage conditions, but from similar parent materials. These catenas or groups are given the name of the best developed or zonal soils, which are the Sassafras, Norfolk, and Craven.

The Sassafras catena includes all members of the Sassafras, Woodstown, Dragston, and Fallsington series. These soils have developed from similar parent materials but under conditions of drainage that range from good to very poor. Relief has also played an important part in the development of the normal soil profiles. All soils in the Sassafras catena are characterized by a light-textured C horizon consisting mainly of sands, light sandy loams, and gravel more or less intermixed.

The Norfolk catena is not so well developed in Princess Anne County as farther south, where the Norfolk and associated soils predominate in certain localities. In this county the Norfolk, Moyock, and Portsmouth soils may be considered in the Norfolk catena, as they have sandy clay C horizons of slightly heavier texture than in the Sassafras catena.

Those soils in the county that have heavy silty clays or clays in the B horizon and heavy clays in the C horizon have, for the sake of convenience, been placed in the Craven catena. These include the Craven, Lenoir, Bladen, Elkton, Bayboro, and Hyde. They occupy flat or almost level relief for the most part, and except for the Craven all are imperfectly to poorly drained, none has a normally developed profile, and all are underlain by beds of heavy clays.

The groups of miscellaneous land types, or classifications of material, are not definite soil types. Some areas of the tidal marsh are incipient stages of Bladen soils.

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ROBERT M. SALTER, CHIEF
DIVISION OF SOIL SURVEY, CHARLES E. KELLOGG, CHIEF
MAP DRAFTING J. W. MEEKS, HER. IN CHARGE

SOIL MAP

PRINCESS ANNE COUNTY
VIRGINIA

VIRGINIA AGRICULTURAL EXPERIMENT STATION
A. W. DRINKARD, JR., DIRECTOR
T. B. HUTCHESON, HEAD, DEPARTMENT OF AGRONOMY
S. S. OBENSHAIN, IN CHARGE SOIL SURVEY

LEGEND

WELL-DRAINED SOILS

REDDISH-BROWN SUBSOILS

- Sassafras fine sandy loam — Sf
- Sassafras sandy loam — Ss
- Sassafras silt loam — Ss

YELLOW SUBSOILS

- Craven fine sandy loam — Cf
- Norfolk loamy fine sand — Ne
- Craven silt loam — Cs
- Woodstown fine sandy loam — Wf
- Norfolk fine sandy loam — Nf
- Woodstown sandy loam — Ws
- Woodstown silt loam — Ws

IMPERFECTLY DRAINED SOILS

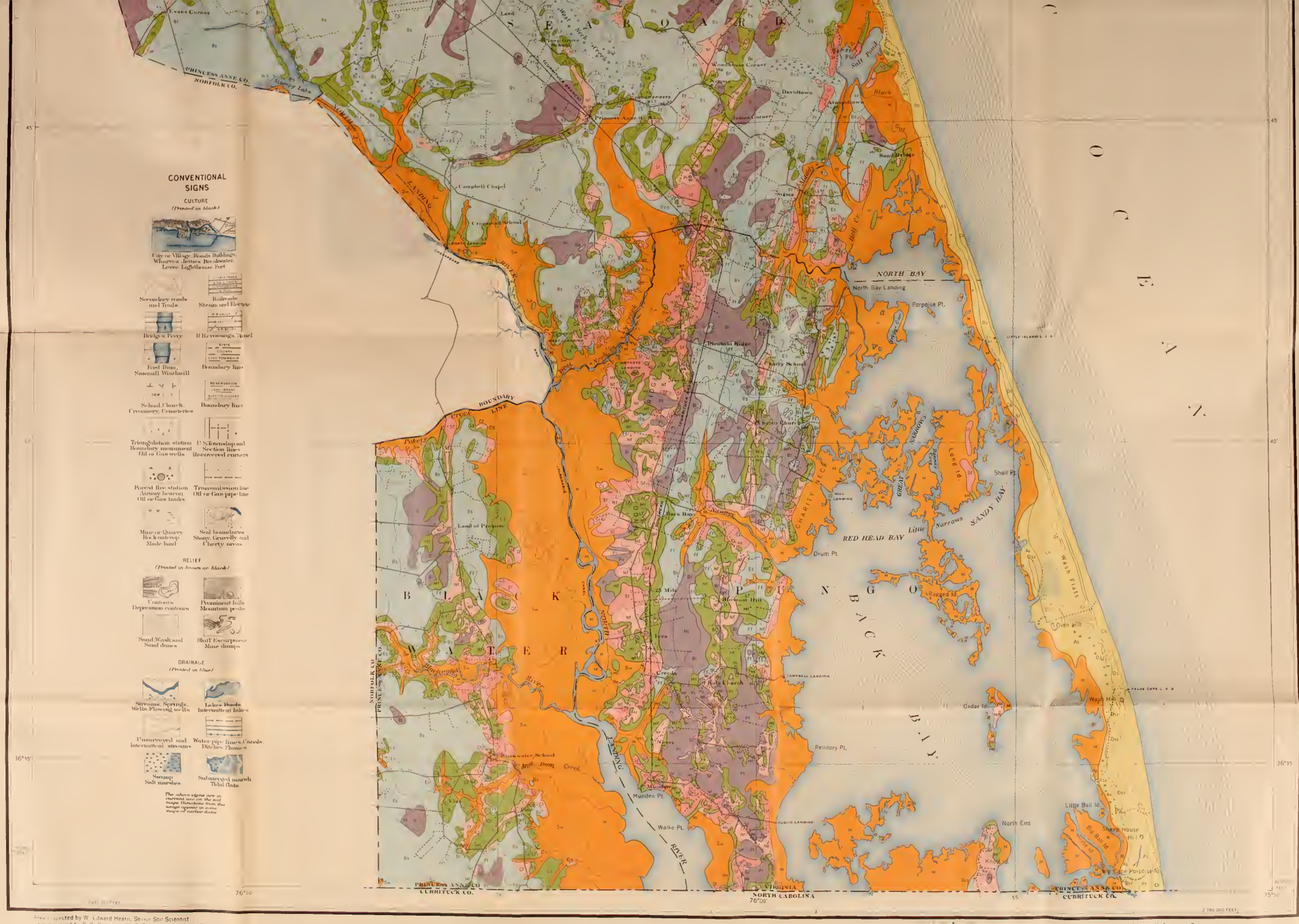
- Dragston fine sandy loam — Df
- Lenoir fine sandy loam — Lf
- Dragston sandy loam — Ds
- Lenoir silt loam — Ls
- Dragston silt loam — Dm
- Moyock fine sandy loam — Mf

LIGHT COLORED POORLY DRAINED SOILS

- Bladen fine sandy loam — Bf
- Bladen silty clay loam, swamp phase — Bcs
- Bladen silt loam — Bs
- Elkton silt loam — Es
- Fallington fine sandy loam — Ff

DARK-COLORED POORLY DRAINED SOILS

- Bayboro silt loam — Bl
- Hyde silty clay loam — H



CONVENTIONAL SIGNS

CULTURE
(Printed in black)

City or Village, Roads Buildings, Wharves, Jetties, Breakwater, Levee, Lighthouse, Fort

Secondary roads and Trails

Railroads Steam and Electric

Bridge, Ferry

R.R. Crossings, Tunnel

Fixed Dam, Sawmill, Windmill

State, County, Civil Township

Boundary line

School, Church, Creamery, Cemeteries

Reservation, Land Grant, Civil Township

Boundary lines

Triangulation station, Boundary monument, Oil or Gas wells

U.S. Township and Section lines, Recovered corners

Forest fire station, Airway beacon, Oil or Gas lights

Transmission line, Oil or Gas pipe line

Mine or Quarry, Rock outcrop, Made land

Soil boundaries, Stony, Gravelly and Cherty areas

RELIEF
(Printed in brown or black)

Contours, Depression contours

Prominent hills, Mountain peaks

Sand Wash and Sand dunes

Bluff, Escarpment, Mine dumps

DRAINAGE
(Printed in blue)

Streams, Springs, Wells, Flowing wells

Lakes, Ponds, Intermittent lakes

Unsurveyed and intermittent streams

Water pipe lines, Canals, Ditches, Flumes

Swamp, Salt marshes

Submerged marsh, Tidal flats

The above signs are in current use on the soil maps. Structures from the latest reports in many maps of earlier dates

DARK-COLORED POORLY DRAINED SOILS

Bayboro silt loam	Hyde silty clay loam	Portsmouth loam
Bh	Hc	Pt

MISCELLANEOUS LAND TYPES

DRY, OR COMPARATIVELY DRY

Arzell sand	Dune sand	Coastal beach	Dune sand, stabilized phase	Made land	Pits
As	Ds	Cb	Dsz	Md	

WET

Marsh	Swamp dune sand complex	Swamp	Tidal marsh
M	SwD	Sw	T

Area inspected by W. Edward Hearn, Senior Soil Scientist
Soils surveyed by C. S. Simmons, U. S. Department of Agriculture, in charge, and Edward Shuleum, Virginia Agricultural Experiment Station.

Scale 1:62500
1 0 1 2 3 4 5 Miles
1 0 1 2 3 4 5 6 Kilometers

Polyconic projection, 1927 North American Datum
Horizontal control by U. S. G. S., and U. S. C. and G. S.
Base map in part from U. S. Geological Survey Sheets
10000 foot grid based upon Virginia (South) system of plane coordinates
Surveyed in 1937-39. Series 1939.

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Areas surveyed in Virginia shown by shading.